ELECTRONICS Australia

HIFI NEWS

OCTOBER, 1974
AUST 75c* NZ 75c

new sony 3-head cassette decks

Hifi product reviews

NEW CAR RUNS ON STORED HEAT!

STEREO CASSETTE DECK, ORGAN VIBRATO

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Freedom in a happening world

. . . any sound, any time, anywhere. In a nutshell the new TC-152SD has:
*Portable cassette deck for use both outdoor and indoor. *Built-in amplifier and speaker for easy monitoring. *Dolby *NR system. *DC-DC convertor for wider dynamic range. (It increases the saturation level of the recording amplifier from 6V to 24V.) *Microphone attenuator. *Tape selector. *Limiter.

Power requirements: AC 120, 220 or 240V, 50/60Hz DC 6V, 4 "D" size batteries, rechargeable battery pack BP-8 (optional), 12V car/boat battery with car battery cord DCC-128 (optional). **Frequency response:** "Cr02" 30-15,000Hz, "Normal" 30-13,000Hz. **Flutter and wow:** 0.15% wrms. **Signal-to-noise ratio:** Dolby NR off: 48dB, Dolby NR on: improves up to 5dB at 1kHz, improves up to 10dB above 5KHz. **Dimensions:** 108 (W) x 378 (H) x 238mm (D) (14⅞ x 4¼ x 9⅜"). Weight: 5.4kg (11lb 15oz).

With all these power packed features you can Dolby NR stereo recording and playback anywhere, without having to take a studio along. Complete your portable studio with the high quality ECM-280 unidirectional microphone and you have freedom in a happening world.

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SO 6

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Australia's largest-selling electronics & hi-fi magazine

VOLUME 36 No 7

Flat display panels to replace the cathode ray tube and the TV picture tube have been under development for a long time. While there is still much to be done, the technique has been developed to the point where it is quite practical for many specialised displays. Read all about the Self-scan Panel Display on page 72.

Something for organ enthusiasts. A phase-shift vibrato system which can be easily added to an existing organ and so wired as to provide the effect independently on individual manuals. Story on page 42.

PROJECT COMPETITION

As this issue went to press, the last of the entries in our project competition have been coming to hand, postmarked September 2. We now face the massive task of reading and evaluating the entries prior to allocating the prizes, which have been offered by Kitsets Australia Pty Ltd. If we can reach a decision in time for the November issue, we will announce the prizewinners then. Otherwise, the results and the winning entry will be published in December.

On the cover

From a cat's purr to a clash of cymbals! This is the theme that inspired our cover picture, inspired in turn by two new Sony cassette decks; the TC-137SD and the TC-117SD Both are reviewed in Hi-Fi News on page 9. (Photo by courtesy Sony Kemtron).

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world of electronics and hi-fi

projects and technical

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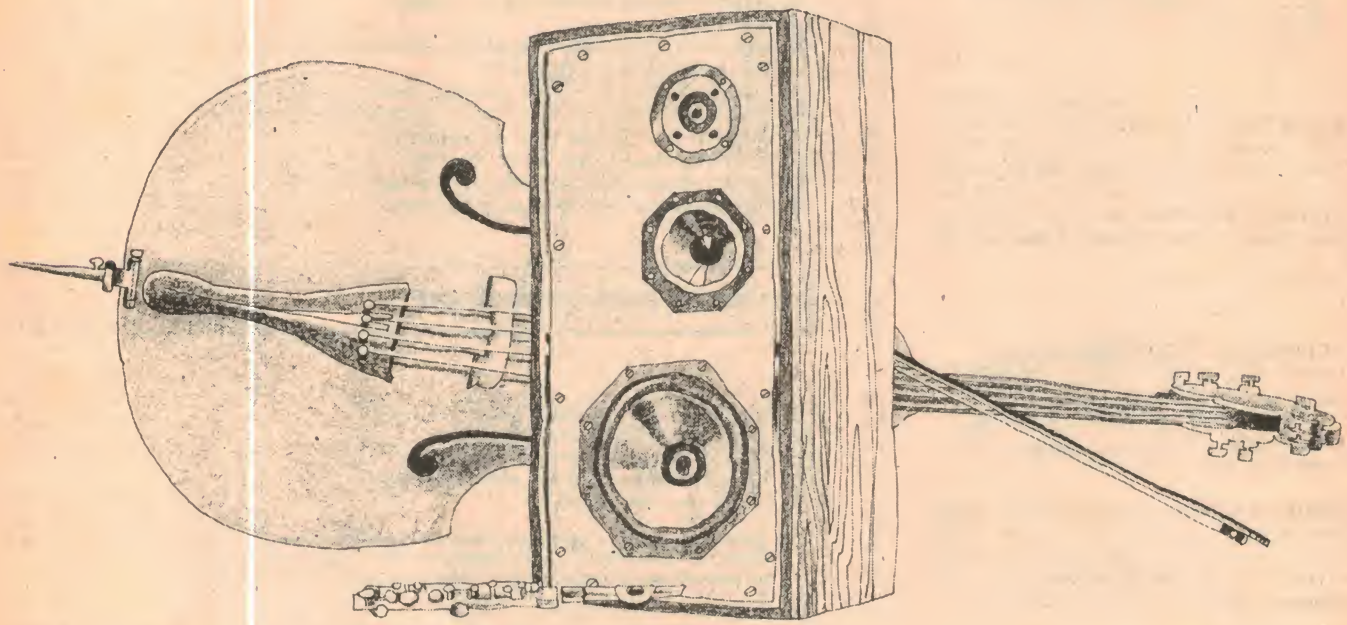
PHILIPS

How can you afford a really good speaker system that has minimal distortion?



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153 60

Editorial Viewpoint

With PALs like these, who needs . . .

One of the advantages of being a "follower" rather than a pioneer, in terms of technology, is that you can learn from the experience of those who do pioneer — and their mistakes, if they make any. The more complex the technology concerned, the more valuable can be this advantage.

Australia certainly had the opportunity to profit from the experience of others when it came to colour TV. This fact was very much appreciated by the engineers who selected the system we will be using, and established the appropriate technical standards. And there is little doubt that the resulting system has the potential to give the Australian TV viewer colour pictures of a quality second to none.

Just as with any other application of technology to consumer products, it is almost inevitable that there will be some variation in the extent to which this potential to display outstanding colour TV pictures will be realised in practice. Most of the variation will be introduced at the last, and weakest link in the chain: the way in which the colour receiver is adjusted by sales staff, installers and the viewer.

It would be unrealistic to expect that all colour TV receivers could ever be correctly adjusted, no matter how much time and effort could be spent upon staff and viewer training. However the fact remains that unless a reasonable proportion of receivers are properly adjusted, at least in the showroom, colour TV will make very much less impact upon the public than it could. And already, in the few short weeks that colour receivers have been on display in the stores, we have come across many examples of receivers quite glaringly misadjusted.

In fact it is not at all uncommon to find a group of colour receivers, each displaying a noticeably different version of the same program material. In this sort of situation, it would be quite understandable if the potential customer were to walk away unconvinced and emptyhanded.

Superficially, the store showroom might seem to play only a transient and indirect role in determining the success or otherwise of a technology such as colour television. Yet in most cases this is virtually the only place where the consumer public come into contact with the industry. And if it presents the end product in a poor light, much of the effort of the industry will be wasted.

In view of this it seems to me that receiver manufacturers in particular, and perhaps also the TV broadcasters, should be exerting pressure to ensure that receivers are correctly adjusted and presented in the store showroom. If they don't, they'll have no one to blame but themselves if the public hasten slowly.

— Jamieson Rowe

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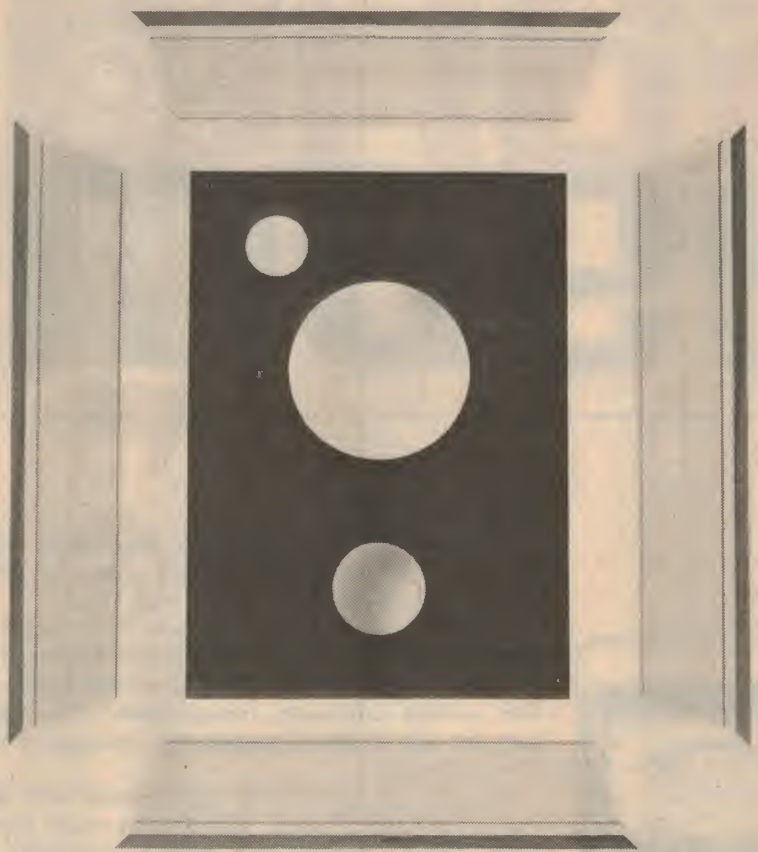

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*Loudspeakers are not included in the kits.

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This 1.8 cubic foot cabinet is recommended for optimum performance with the Plessey C80 woofer and two C3GX tweeters. The complete system provides an extremely attractive overall performance at very reasonable cost.

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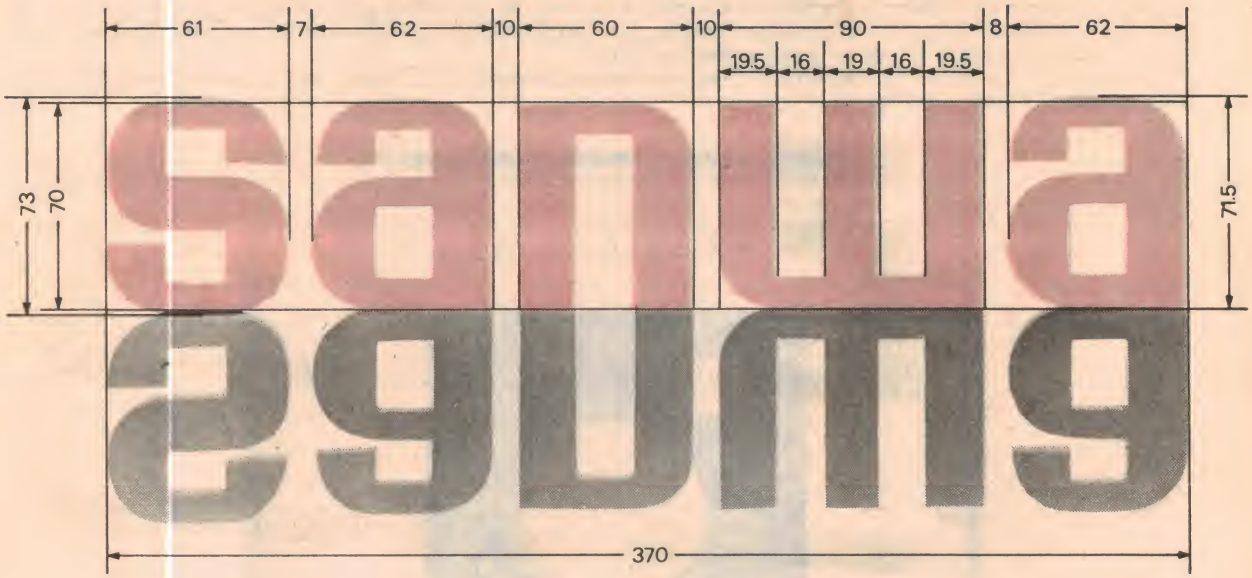
AR66A

The name's the same, just the style's been changed.

From SANWA to sanwa



Why the change?

Because besides being more attractive, we think the new style presents a sharper image of precision. And precision is what Sanwa is all about.

For thirty years now we've been manufacturing precision measuring instruments. For customers throughout the world (in over a hundred countries, so far). For service engineers, researchers, radio hams—in fact for all kinds of people and companies involved in electronics.

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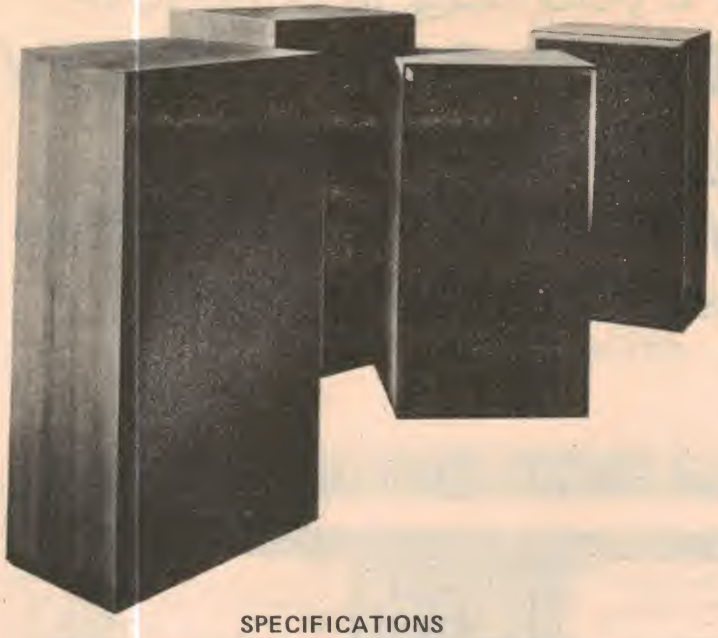

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BOOKSHELF SPEAKER SYSTEMS

FEATURES

- Die-cast transducer frames to prevent undesirable resonance
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- Soft-dome transducers for smooth midranges and trebles
- High temperature voice coil bobbins for superior overload capacity
- Low resistance crossover networks for minimum power loss and better speaker damping
- Extra-thick cabinet laminates for maximum structural stability.

SPECIFICATIONS

	NS-690	NS-670
Frequency response	35—20,000Hz	40—20,000Hz
Power handling capacity	60 watts	50 watts
Nominal Impedance	8Ω	8Ω
Type	3-way	3-way
Woofer	300mmϕ cone (JA-3056)	250mmϕ cone (JA-2501A)
Midrange	75mmϕ soft dome (JA-0701)	60mmϕ soft dome (JA-0601)
Tweeter	30mmϕ soft dome (JA-0509)	30mmϕ soft dome (JA-0509)
Crossover frequencies	800Hz, 6,000Hz	800Hz, 6,000Hz
Fundamental resonance frequency (f_o)	40Hz	45Hz
Operating power*	4 watts	6.3 watts
Dimensions	630mm H×350mm W×291mm D (24¾"H×13¾"W×11½"D)	577mm H×320mm W×269mm D (22¾"H×12⅝"W×10⅝"D)
Weight	22kg (48 lbs.)	19kg (42 lbs.)

*Input electrical power required to obtain 96dB sound pressure level at 1 meter according to DIN 45500. Specifications subject to change without notice.

CROSSOVER NETWORK

Yamaha have developed a totally new crossover network for the NS-600 series systems. It features special coils having extra thick 1mm diameter copper wire wound around ferrite cores. The copper wire minimizes power loss, and improves speaker damping because of its low electrical resistance. The use of ferrite cores offers similar advantages since it reduces the number of coil windings. Also utilized are metallized paper capacitors which, because of their low power loss factor, help to improve tonal quality. The NS-690/670 series crossover frequencies are 800Hz between woofer and midrange, 6,000Hz between mid-range and tweeter, and have a cut-off characteristic of 12dB/oct.

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Hi Fi News

Sony's new three-head cassette deck

Emphasising the upward trend of cassette technology, Sony have recently released a new top-of-the-line model, designated — TC-177SD. It has separate erase, record and replay heads, a closed loop dual-capstan drive, Dolby facilities and provision for Sony's new ferri-chrome cassette tape. Sony is promoting it as a direct competitor, in the quality market, with open reel machines.

With very few exceptions, cassette decks to date have carried only two heads, one for erase and the other for record and playback. While 2-head technology has been developed to the point where eminently satisfactory results are possible, some compromise in head design is necessary to reconcile the conflicting requirements of recording and playback. In addition, the need to switch the head from amplifier output to amplifier input poses problems of circuitry and layout.

By having separate record and playback heads, as is common in the higher quality open-reel decks, each can be optimised for its own particular function. And, if each has its own distinct circuitry, the two can be used simultaneously in conjunction with an amplifier having tape monitor facilities. Thus, while a program is being recorded, it is possible to listen alternatively to the input signal, or to the signal off the tape, comparing the two in terms of quality, noise level, etc.

If the level on the tape is too high or too low, running into distortion or noise, correction can be made immediately. If high frequency response is poor, or erasure is incomplete, it may indicate that the bias or compensation has not been switched to suit the tape. It is obviously better to be alerted to such problems at the start of a recording, rather than after the operation has been completed half an hour later!

Physically, the erase head and playback head occupy their normal positions in relation to the cassette. The additional (record) head is located between the two and contacts the tape through the small rectangular hole in a cassette alongside the record/play slot.

In the Sony TC-177SD, the record and replay heads are both of "ferrite and ferrite" design — a term which indicates that the material is used both for the core and the guide portion of the head. Sony claim this to be desirable to achieve minimal but even wear, and therefore maximum head life, with chromium dioxide tape in particular.

Gap width of the playback head is 0.9 micron, as compared with 7 microns in the record head.

A further uncommon feature of the TC-177SD deck is the use of a closed loop, dual capstan drive system, intended to provide the smoothest possible tape transport and a substantial degree of immunity from irregularity in the tape and capstan mechanism.

In fact, Sony see the dual-capstan as a virtual necessity in a 3-head deck. While the normal pad within a cassette will hold the tape against the replay head, contact between the tape and the additional (record) head is dependent entirely on the tape flow and tension. Any irregularity can produce uneven contact and a poor recording as a result. The accompanying diagrams illustrate the positions of the dual capstans, pinch rollers and heads relative to the deck face and cassette.

The dual capstan system, operating in conjunction with a 6-pole hysteresis synchronous motor reduces wow and flutter to a low 0.07pc.

Other features of the TC-177SD deck are summarised as follow:

BIAS, EQUALISATION: A selector switch offers three levels of bias — low, medium and high. This, along with a second switch controlling equalisation, allows the performance to be optimised for ferric, ferri-chrome or chromium dioxide tape.

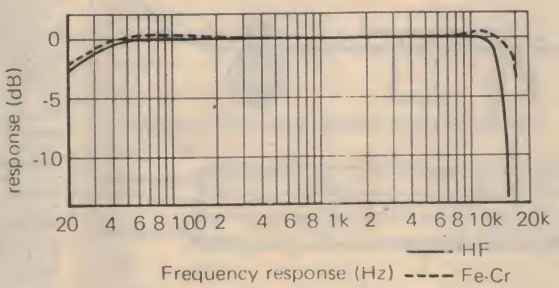
DOLBY: Like many other current cassette decks, the TC-177SD has in-built Dolby facilities. However, the deck goes a step further in providing an in-built 400Hz oscillator and means for optimising the Dolby level for the particular tape in use. A further facility allows the deck to be optimised for recording Dolby-encoded broadcast FM.

FM MULTIPLEX FILTER: Purpose of this is to eliminate from the audio circuits in the deck the 19kHz pilot tone and 38kHz subcarrier involved in FM / stereo broadcasts.

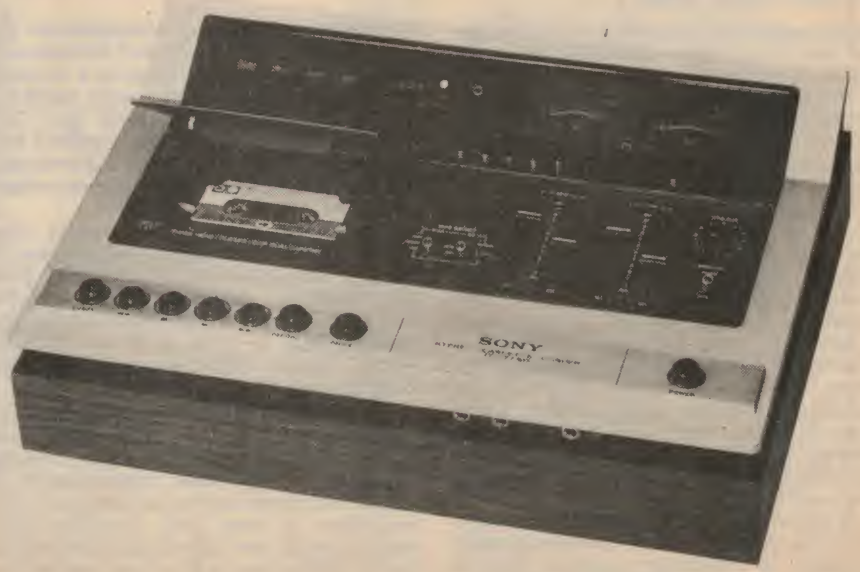
MIXING FACILITY: As an aid to adding voice to other program material, the TC-177SD deck provides full mixing for microphone and line inputs.

LINE OUTPUT: Permits the output level to be adjusted to suit the associated amplifier.

PEAK LEVEL INDICATORS: Light emitting diodes which flash on overload peaks to brief to show properly on the regular recording level meters.



The manufacturer's published response curve for the TC-177SD cassette deck. The solid curve is for standard high quality ferric tape, the dotted curve for ferrichrome tape with slightly modified bias level and equalisation. An independent review of the TC-137SD published overseas tends to confirm the order of difference between the two tapes.



The new Sony TC-177SD recorder, which is intended to compete in the high performance league. In the rear, left corner, operating mode is shown by illuminated indicators. To the front right, a monitor switch gives a choice of signal entering the deck or picked off the tape immediately after recording.

AUTO SHUT-OFF: Operates on any mode.
MEMORY COUNTER: Over and above its normal function of indicating tape traverse, the counter can be set up to select the start point of a given track on the tape.
SPECIFICATIONS: Response with Cr02 or "FeCr" tape is 30Hz to 18kHz (DIN) or 30Hz to 15kHz (DIN) with "normal" tape. S/N ratio: 53dB with normal tape, 55dB with Cr02 or FeCr tape; further 5 to 10dB potential improvement with Dolby. Distortion: 2pc.

A new companion deck to the TC-177SD is the TC-137SD, also pictured on the cover. As will be apparent, the styling is very similar but the 137 is a scaled down design, and a less expensive one.

The main point of difference is that the TC-137SD is a conventional 2-head deck, with combination record/replay head, and therefore lacking the facility to monitor the tape while it is being recorded.

It also employs a normal single-capstan open loop tape drive system but, thanks to the drive motor, a generous flywheel and special rectangular belt, the wow and flutter figure is the same as for the more expensive machine: 0.07pc.

Most of the other facilities are retained — ferrite and ferrite head, provision for the same three classes of tape, peak level indicators in addition to VU meters, Dolby and automatic peak limiting, automatic stop in all modes, "memory" tape counter, lockable pause button, microphone mixing, line output control, etc.

In terms of specifications, the TC-137SD falls only slightly short of the 3-head model in terms of frequency response: 30Hz to 15kHz (Din) with standard tape and 30Hz to 17kHz (DIN) with FeCr or Cr02 tape. Signal/noise ratio is much the same at 55dB before the application of Dolby, while rated distortion is actually lower at 1.7pc.

Finally, what is all this about Sony's ferrichrome tape?

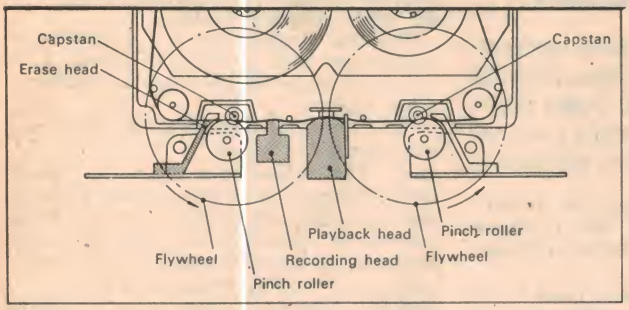
Recording tape has conventionally been coated with iron oxide particles (Fe203), being loosely described as ferric or ferrous tape.

Faced with limited performance at the standard cassette speed of 4.8sm/s, some manufacturers evolved a chromium dioxide (Cr02) coating, which offered improved frequency response and dynamic range — provided suitable adjustment was made to the recording bias and the equalisation.

While many decks now incorporate the necessary switching to accommodate the needs of Cr02 tape, improved formulations have maintained ferric tapes in a strongly competitive position, with vastly improved performance just short of the best Cr02 tape, but without the need for modified bias and equalisation. What's more, Ferric tape is generally less expensive and more widely available.

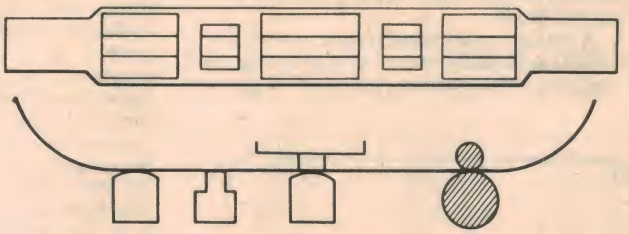
Sony's new ferrichrome cassette tape seeks to realise the best of both worlds. It uses a "strengthened polyester 12u" base for maximum reliability and strength, along with a two layer oxide coating. The main coating is a 5u layer of "gamma Fe203" (ferric, iron oxide) with an outer coating of 1u chromium dioxide.

The new ferrichrome tape can be used to advantage with the same bias and equalisation as modern ferric tape, offering a small but significant improvement in signal/noise ratio and in the extreme treble response. In fact, the "ferrichrome" position on the new Sony decks does provide slight adjustments to bias and equalisation to optimise them for the new tape. In these circumstances, the machine specifications suggest that the end result with ferrichrome tape and chromium dioxide tape is virtually identical.

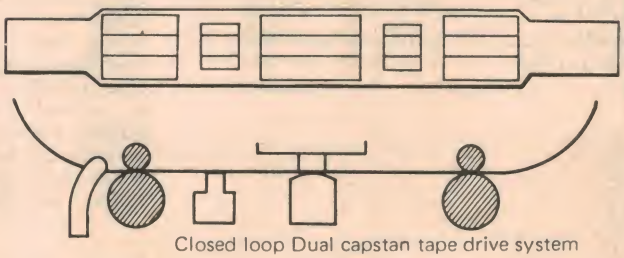


Illustrating the relationship between the heads, capstans, pinch rollers, and the cassette, for a 3-head dual capstan deck. Because of the second capstan, the erase head has to be oddly shaped to fit alongside the pinch wheel.

With a 3-head system and a single capstan (top) there is no special problem in fitting in the extra (record) head. However, because there is no pressure pad for the record head, contact must rely on tape tension and smoothness. Sony overcomes the problem by providing a dual capstan system (bottom) but this necessitates the use of an erase head shaped to penetrate the cassette in the small space left by the extra pinch wheel.



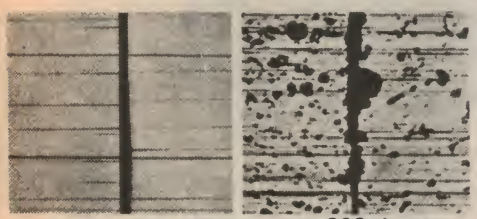
Open loop single capstan tape drive system



Closed loop Dual capstan tape drive system

The Jeweller and the Gem

The jeweller and the gem are part of why AKAI Cassette Recorders and Decks deliver such incredibly clear sound. Each AKAI GX Recording and Playback Head is cut by a Jeweller, with such skill and precision that the sound



* After equal use. Enlarged to 800 times

Gap environs of AKAI Single Crystal Ferrite Head

Gap environs of Poly-Ferrite Head

See how AKAI delivers cleaner, clearer sound

reproduced is clearer and cleaner than that obtained from any other type of head.

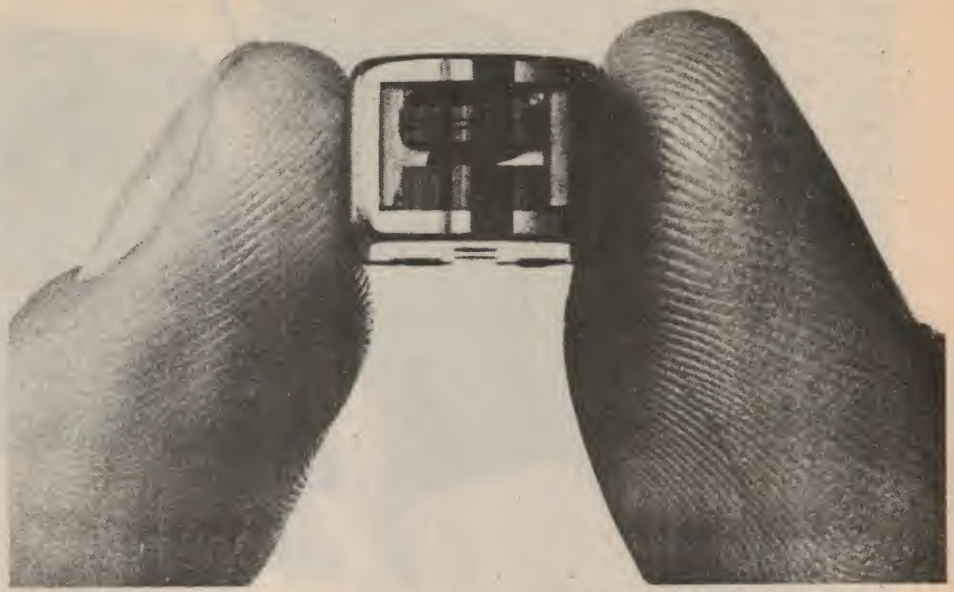
That's one reason why AKAI Cassette Recorders and Decks are superior. But it is by no means the only one.

For example: The GXC75D (centre) in addition to the GX Head has AKAI's Automatic and Manual Reverse Recording and Playback System (for continuous playback and recording). Plus AKAI's exclusive ADR (Automatic Distortion Reduction) System, which automatically adjusts the recording level signal to prevent high frequency distortion. The combination of this with the Dolby Noise Reduction System, and a special Tape Selector Switch puts the GXC75D in a class by itself.

The GXC46 (left) also boasts the lifetime guarantee GX Head, the ADR System, Dolby Noise Reduction and Special Tape Switch. As well as the OLS (Over Level Suppressor) circuit to eliminate distortion at maximum input.

Likewise the GXC38 (right) is equipped with the GX Head, Dolby Noise Reduction, OLS and a Special Tape Selector Switch for CrO2 (Cromium Dioxide) tape.

AKAI equipment (whether cassette decks or recorders, tape decks or recorders, amplifiers,



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FREQUENCY MODULATION BROADCASTING:

Proposed Australian Standards

Whether or not an FM/stereo broadcast service is implemented in Australia with the speed planned and hoped for, the Australian Broadcasting Control Board is moving to fix the standards around which such a service would be built up. Draft standards, as set out below, were recently circulated to the industry for comment, which must be before the Board not later than November 22 next.

Immediately after the due date, the Board proposes to examine the comments, alongside the original draft, and to derive firm standards for official promulgation.

The draft standards, as set out below, refer primarily to transmission methods and therefore to the basis on which receivers should operate. Many other matters involving technical facilities within studios, lines, program links, etc will be the subject of separate consideration.

Examination of the draft standards indicates that Australia will align itself with the broad practice of FM/stereo overseas, rather than with the standards in any one country or group of countries. Thus, the standards envisage a full 88-108MHz spectrum, which is similar to the USA and Canada but wider than European practice or domestic Japan. Pre-emphasis will be in line with European (and likely future USA) practice but provision is envisaged for an ultimate supplementary mono channel, in line with American practice. "Dolbyised" transmission is also in view.

In short, whereas earlier proposals for a second broadcasting systems in Australia would have made it unique, the present draft standards virtually align completely with Japanese export receivers.

Appended to the draft standards is a table of channel numbers and frequency allocations. The numbers begin with channel 201 (88.0-88.2MHz), followed by channel 202 (88.2-88.4MHz) and so on. Channel 300 neatly occupies the final allocation (107.8-108.0MHz).

For the rest, the draft standards read thus:

These Standards are consistent with international Standards for the pilot-tone stereophoinic system, thereby ensuring maximum interchangeability and utilisation of imported equipment and established technical developments. Some of the parameters of VHF-FM services vary from one part of the world to another eg USA, Japan, Europe; and in this regard the following quantities are proposed for use in Australia.

FREQUENCY RANGE: 88-108MHz

As used in USA, Canada and recommended in McLean report. Japanese domestic receivers tune from 70-90MHz, but most of their export is to USA standards 88-108MHz. European FM receivers generally cover 88-104MHz (there are relatively few European FM stations above 100MHz). The dominant use of TV ch5 (101-108MHz) for Phase 1 of FM development requires receiver coverage up to 108MHz. The special situation which will obtain in Australia for some, if not many, years is that the 88-108MHz band will require to be shared between TV and FM transmissions.

DEVIATION: plus, minus 75KHz

PRE-EMPHASIS: 50 micro-seconds

Applies in both baseband (L + R) and stereo (L — R) channels. Experimental use of noise reduction systems such as Dolby B, accompanied by a reduction in pre-emphasis to 25 micro-seconds, would be permitted. This would be expected to make the difference in monophonic and stereophonic coverage less obvious.

POLARISATION; mixed

Some form of mixed polarisation to improve reception in motor vehicles, and by hand-held and other portable receivers. (Initial transmissions are likely to be horizontally polarised, for speed in transmitting aerial provision.)

SUPPLEMENTARY MONOPHONIC TRANSMISSION: Optional

As used in USA, Canada. It is important

Pioneer: new FM/AM tuner/amplifiers

According to Doug Bell of Pioneer Electronics Aust Pty Ltd, awareness of FM among hifi dealers and the buying public "is taking off like a rocket". In line with this, Pioneer has announced a complete range of no less than seven FM/AM tuner amplifiers.

The range begins with the SX-434 at a recommended retail price of $279. Though the least expensive of the seven units, the SX-434 would nevertheless keep most audiophiles more than happy. The FM tuner is of modern design with a FET front end, IC and ceramic filters, a sensitivity of 1.9uV, excellent selectivity and capture ratio and muting. IC technology is featured also in the AM tuner.

The amplifier section of the SX-434 has full input and control facilities, full interconnection for tape decks, provision for two pairs of loudspeakers, click-stop tone controls and so on. Power output is 15 + 15W RMS, and rated distortion level 0.8pc at full power or 0.1pc at 1 + 1W RMS.

From that notable start with the "baby" of the range, other models progress as follow: SX-535, 2x20W, $375; SX-636, 2x25W, $425; SX-737, 2x35W, $519; SX-838, 2x50W, $639; SX-939, 2x70W, $739.

Physically, the tuner/amplifiers are obviously part of a carefully planned range, with satin finished metal panel, metal knobs, black tuner panel with blue-illuminated dial scales, and wooden case. The models grow in size and facilities commensurate with the power and price.

At the top of the range is the SX-1010 pictured above —a receiver/amplifier with a whopping 100x100W RMS output at a recommended retail price of $849. However, the purchaser is not buying only power output; facilities and specifications are also appropriate to a unit in this class. For example, distortion is quoted at less than 0.1pc at rated power. Again, the FM tuner has a 5-gang capacitor for peak front-end performance.

(Details of any of the amplifiers are available from Pioneer Electronics Aust Pty Ltd, 256-8 City Rd, Sth Melbourne 3205, or from branches in other capitals).

TEL-26 DYNAMIC $36.95

TEL-14/TWO-WAY
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TEL-29/LIGHTWEIGHT $19.95

TEL-111/ELECTRET $85.00

TEL-32Q/QUAD,
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The TEL-111 ELECTRET Headphone, for example, incorporates the latest advances in electrostatic audio reproduction providing flat frequency response from 18 to 24,000 Hz, without the need for the conventional electrostatic power supply. And it reduces distortion to the vanishing point by using a stiff featherlight . diaphragm suspended between two permanently-charged plates. The result is the clean, crisp, Telephonics sound, unobtainable with any but the most expensive speaker systems.

The TEL-26 DYNAMIC Stereo Headphone reproduces sound so faithfully that once you hear it, you'll never be satisfied with anything less. It has a separate tone control and volume control on each earcup to permit precise volume, balance and tone adjustments. And Telephonics mechanical 2-way speaker system gives you the 2-way sound without the cost.

For the breathtaking realism of quadraphonic sound, the TEL-32Q QUAD, 4-CHANNEL Headphone has two 2-way speaker systems (four speakers in each earcup) to let you discover sound you've never heard before. The Telephonics Balance Controller lets you sit in your favorite easy chair, far from your receiver or amplifier, and set the 4-channel balance exactly the way you want it.

The TEL-14 TWO-WAY Headphone contains a full 2-way speaker system, complete with crossover network in each earcup. Deep, smooth bass response from the woofers and the bright treble highlights of the tweeters overlap to make the presence of the music felt, just the way the artist intended.

The TEL-29 LIGHTWEIGHT Headphone, the "Weight Watcher" member of the family is easy on the budget. Constructed of air-light materials for hours of easy listening, the Lightweight never disturbs nor intrudes on the music, but is not completely isolating. A volume control on each earcup allows you to adjust volume and balance without returning to your amplifier.

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FREQUENCY MODULATION

for designers of FM stereo decoders to take into account the possible presence of supplementary transmissions between 53kHz and 75kHz.

CHANNELS:
The channel width shall be nominally 200kHz. The channel spacing shall be 200kHz, but a carrier off-set of 100kHz may be specified where this is appropriate.

CARRIER LOCATION, MODULATION:
The main carrier shall be centrally located in the channel and shall be frequency modulated by the baseband signal, the peak frequency deviation being plus and minus 75kHz.

POLARISATION:
The polarisation of the radiated signals shall be specified by the Board.

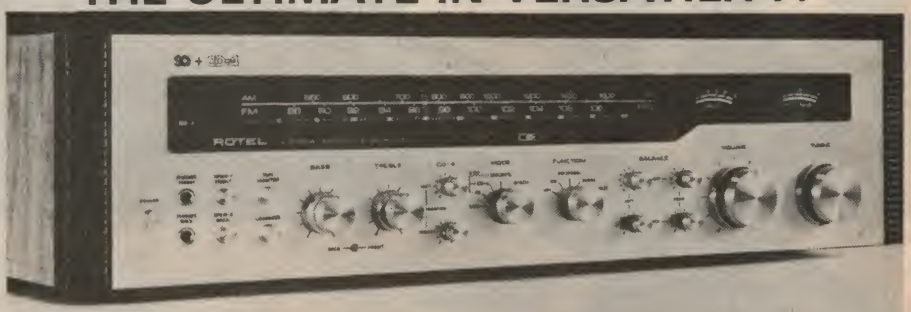
MONOPHONIC TRANSMISSION:
The baseband signal shall be the audio signal components within the band 30Hz to 15kHz. Pre-emphasis of the audio signal shall be in accordance with the impedance/frequency characteristic of a series resistance-inductance network having a time constant of 50 microseconds.

STEREOPHONIC TRANSMISSION:
The pilot-tone system shall be employed for the transmission of stereophinic signals. In this system the baseband signal consists of:—
(1) A compatible signal M, equal to one half the sum of the left-hand signal L, and the right hand signal R, which produces a deviation of the main carrier of not more than ± 67.5kHz,
(2) Sidebands of an amplitude modulated suppressed sub-carrier, the modulating signal S of this sub-carrier being equal to one half the difference between the left-hand and right-hand signals. The sum of these sidebands produces a peak deviation of the main carrier equal to that which the signal S would produce if applied to the channel M. The peak deviation is not more than ± 67.5kHz.
(3) A pilot signal having a frequency equal to one half of that of the sub-carrier, and producing no less than ± 6kHz and no more than ± 7.5kHz deviation of the main carrier. The frequency of the sub-carrier is 38,000 ± 4Hz. The residual sub-carrier produces a deviation of the main carrier of not more than ± 750Hz.
The M and S channels shall pass audio signal components in the band 30Hz to 15kHz.
Pre-emphasis of the M and S signals shall be the same as that for monophonic transmission.
The phase relationship between the pilot signal and the sub-carrier is such that when modulating the transmitter with a baseband signal for which L is positive and R equals —L, the resultant subcarrier signal crosses the time axis with a positive slope each time the pilot signal has an instantaneous value of zero. This condition shall be met to within a tolerance of ± 3 deg. for the phase of the pilot signal.
A positive value of the baseband signal corresponds to a positive frequency deviation of the main carrier.
On an experimental basis, the Board may permit processing of the L and R signals of a stereophonic transmission in accordance with the Dolby B-Type noise reduction system. For such transmissions, the pre-emphasis time constant should be reduced to 25 microseconds.

SUPPLEMENTARY MONOPHONIC TRANSMISSION
Transmission of a supplementary monophonic program on a frequency modulated subcarrier may be authorised by the Board.
The instantantaneous frequency of the supplementary sub-carrier shall be confined to within the baseband range 53kHz to 75kHz.
Modulation of the main carrier by the supplementary sub-carrier shall not exceed ±7.5kHz.
When transmitting a supplementary monophonic program, the total frequency deviation of the main carrier by the combined baseband signals shall not exceed ±75kHz.

DEFINITIONS
CHANNEL: A band of frequencies or a specified path for the transmission and reception of electric signals.
MAIN CARRIER: The VHF signal modulated by the baseband signals.
SUB-CARRIER: A carrier which is applied as a modulating signal to the main carrier.
PILOT SIGNAL: An unmodulated sinewave signal of specified frequency used to regenerate the suppressed sub-carrier, or to permit detection of suppressed sub-carrier modulation.
LEFT-HAND SIGNAL L: The audio signal arriving from the left when facing the sound source or the speaker system.
RIGHT-HAND SIGNAL R: The audio signal arriving from the right when facing the sound source or the speaker system.
M SIGNAL: L + R divided by 2.
S SIGNAL: L — R divided by 2.
BASEBAND: In the process of modulation, the frequency band occupied by all the signals which modulate the main carrier
SUPPLEMENTARY MONO PROGRAM: A second program intended for non-broadcast use.
DOLBY B-TYPE NOISE REDUCTION: A process whereby audio signals of low amplitude in the band above about 1kHz are accentuated prior to transmission, and correspondingly reduced in amplitude on reception, thereby lowering the level of mid to high frequency noise introduced during reception of quiet passages.

THE ULTIMATE IN VERSATILITY?



The new Rotel 4-channel tuner amplifier, model RX-254, must surely have some claim to being one of the most versatile units so far offered the hifi fraternity. For radio reception, it offers two tuners, one for FM/stereo and the other for AM, the latter coupled to a flip-up ferrite rod antenna attached to the rear panel of the unit. It accepts phono, of course, but in-built circuitry can decode either SW matrix or CD-4 discrete, or synthesise 4-channel from ordinary 2-channel recordings.

The remaining controls are what one might expect on a 4-channel system, providing the usual selections of input and mode; volume, bass and treble control, tape monitor, loudness, front and rear loudspeaker switching, and front and rear phones. But there is more to it than that:

The volume, selector, mode and function controls are all concentric, providing a quite novel facility. If operated together, the knobs behave as part of a single, integrated 4-channel system. However, if operated independantly, the front and rear channels can be set up for different roles. Sharing the same input, they can be operated at appropriate levels into loudspeakers in different rooms, or into phones and loudspeakers simultaneously. But, more than that, the channels can accept separate inputs so that quite different stereo program material can be fed simultaneously to different loudspeakers in different rooms. In fact, two people, seated side by side and wearing phones can be listening to entirely different programs.

Power output available from the RX-245 is moderate only and obviously limited by the supply which can be built into the available size. Under forst-case conditions, with all channels dully driven by sine wave, RMS power per channel is 12W. If two channels are carrying most of the load, something approaching 20 + 20W is available into 8 ohms.

The RX-254 is, of course, only one of a large range of Rotel receivers, tuners and amplifiers featuring performance and styling at a realistic price.

The RX202 receiver, for example, offers 15 + 15W RMS and an FM tuner of high performance. IHF sensitivity is 2.9uV, S/N ratio better than 65dB and distortion 0.2pc. Provision is made for simulated 4-channel.

The RX402 has up-graded RF performance, negative feedback type tone controls and a rated power output of 20 + 20W RMS.

Next in the range is the TX602 which features a direct coupled amplifier and a rated power of 35W RMS per channel.

There are four separate tuners in the Rotel range RT1220, RT622, RT322 and RT222. Companion amplifiers — five in all — range from the RA211 at 10 + 10W to the RA1210 at 55 + 55W.

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From the outside, the Leslie Plus 2 systems are conservative. Inside, they're something different!

Some sound sources are sharply defined, others are heavily diffused. But what would you think of a source that won't stay still? One that seems to change ever so slowly as you listen to a sustained sound? Whatever your answer, the question has to do with a recent release on the Australian market: the Leslie Plus 2 quadraphonic sound system.

By W.N. WILLIAMS

To turn back the clock, the May 1973 issue of our associate journal "Electronics News" included the following deliberately provocative paragraph on its "Random Bytes" page:

"A recent issue of High Fidelity magazine carries a full-page advertisement for Leslie loudspeakers — not the well known whirly ones used in electronics organs, but solid furniture-style models intended for domestic stereo and quadraphonic systems. The implication of the advert is that a patented design largely obviates the problems of standing waves in the listening room — a claim that seems as credible at first glance as antigravity and perpetual motion! Whether Australian enthusiasts will have an opportunity to judge for themselves is another matter. If Leslie consumer hifi loudspeakers are being marketed in Australia, it is a very low key operation . . . if we can be permitted the pun!"

That was in May 1973. Some time later we had to qualify the phrase "not the well known whirly ones" when it became apparent from other references that the new Leslie hifi loudspeakers did, in fact, include a motor-driven rotating paddle or reflector.

The reasons for using a rotating element in an electronic organ loudspeaker system are well known and commonly accepted. Heard through fixed loudspeakers, an electronic organ can sound rather bland, particularly in a small listening area. By feeding the signal through a loudspeaker facing into a rotating vane, the listening area becomes filled with a constantly changing pattern of sound, acoustically much more interesting.

A fairly high rate of rotation — typically 7Hz — gives a "theatre organ" effect. A low rate — 1Hz — gives a subtle variation in phase which might suggest echoes and a more complex sound source — hence a larger organ in a larger acoustic environment!

That's fine and dandy, but why would one want to apply the same idea to a home music system reproducing normal program material? Who in their right mind would want a loudspeaker in each corner of the room, going doggedly round and round and doing its own separate thing?

In fact, when Rose Music Pty Ltd sent us a pair of the Leslie systems for inspection and comment, the reality turned out to be a lot less crazy than the supposition. To be sure, the manufacturers are extending and taking advantage of a technology at which they excel, but they have merged it, where appropriate, with established technology

First off, as the name "Plus 2" actually suggests, the new Leslie loudspeakers are intended primarily to supplement an existing high quality two-channel stereo system. While the manufacturers would probably not object if enthusiasts started buying loudspeakers in quadruplicate, this is not the thrust of their publicity. It is along much more practical lines:

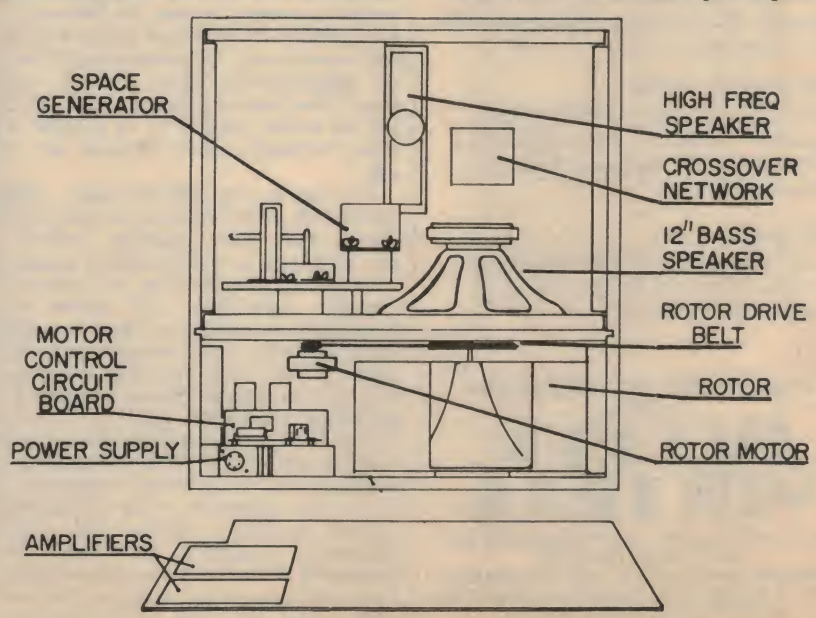
If an enthusiast has a good 2-channel system and wishes to convert to quadraphonic, he faces certain options:

1. To purchase a new 4-channel amplifier and a pair of loudspeakers, discarding the present amplifier, which may well be a high quality unit.
2. Retain the present amplifier but supplement it with a decoder, a second 2-channel amplifier and two extra loudspeakers.

With their Leslie Plus 2 system, Electro Music/CBS Musical Instruments suggests a further option:

3. Retain the present 2-channel system, supplementing it now with a pair of Plus 2 powered loudspeakers, and later with a decoder adaptor to cope with matrix and/or CD-4 discrete discs.

As a first step, the Plus 2 loudspeakers are simply installed in the "rear" corners of the listening room and interconnected with one another, with a mains power point and



Take the back off the Leslie Plus 2 main cabinet and this is what you find. Real surprise is the 360-degree phase shifter for the upper register.

LESLIE PLUS 2

with the existing amplifier. The mains supply powers the in-built dual amplifier while the necessary signals are picked up from the existing L and R loudspeaker feedpoints.

The supplementary dual 50W RMS amplifier is housed in one of the Leslie cabinets, a panel at the rear supporting power and mode switches, input connector and supplementary volume controls. These allow proper left/right front/rear balance to be adjusted for acceptable surround sound.

Literature supplied by Rose Music Pty Ltd indicates that there are two versions of the Plus 2 system. The model 430, supplied for our inspection, has two loudspeakers in each eabinet — a 12-inch driver handling frequencies up to about 800Hz, and a rectangular throated tweeter for the higher frequencies. The cabinets each measure (approx) 29½ x 25 x 18½ inches.

Model 450 is larger (33 x 29½ x 20 inches) and contains a 15in woofer, two 9 x 6in midrange and a dome tweeter.

And here an interesting point emerges. When connected in the recommended fashion, and simply fed from the existing L and R signals, the channels are deliberately crossed over. Thus the L signal feeds the front left loudspeaker and the diagonally opposite rear loudspeaker. Similarly for the R signal. The CBS/Leslie wiring therefore supports the contention referred to in "Forum" that a diagonal connection is to be preferred for a surround effect, as distinct from simple double stereo.

If this was to be the end to the Leslie proposition, there would be little to distinguish it from any other similarly proportioned powered loudspeaker — but here the vital difference emerges: the Series 2 system includes a rotating element which modifies the phase and directional qualities of the signal being propagated, in traditional Leslie style.

In the model 430, the 12-inch bass speaker faces downwards into a moulded rotor which reflects the sound through 90 degrees, so that it sweeps across the listening area horizontally. In the larger model 450, the 15-inch woofer also faces downwards but into an appropriately large, curved wooden rotor. The scanning speed is not specified but we would judge it to be similar to the slow "celeste" speed provided for organ use.

But that is only half the story. Another motor belt drives a large eccentric pulley, along with two separate pulleys on the underside of a mysterious metal box.

Removing the lid of the box reveals two variable capacitors with driven rotors operating at different and constantly varying speeds, each scanning four sets of stator plates. No circuitry is available for the unit but it reminded us strongly of the scanning capacitor used in tone-wheel Hammond organs to produce phase vibrato.

Inspection of the output waveform on a double-beam oscilloscope suggested that the driven capacitors were advancing the signals cyclically through 360 degrees, producing resultants that were simply frequency shifted relative to the inputs. At least, that was what it looked like on the CRO screen and one could have an interesting argument as to whether the effect is a trick of CRO display and whether the frequencies are actually being modulated by a plus and minus amount.

With a square wave fed into the modulating system, there is a highly curious display of the square wave transients remaining at the original frequency while the lower frequency components of the same signal move past them at an even rate.

The Leslie literature merely makes reference to 360-degree phase shifting and leaves it at that.

Details aside, the end result is that the signals fed to the respective tweeters are phase modulated at slightly different low frequencies, of the same order but not necessarily identical to the drum scanners. In short, not only do the Leslie Plus 2 loudspeakers produce an effect of surround sound by simple diagonal connection but they impart a distinction to the rear sounds by random phase modulation.

Synthetic? Of course it is and it recalls some of the early Japanese 4-channel synthesisers which envisaged phase modulation of the rear channel amplifiers by schemes similar to the organ phase modulator described elsewhere.

But then all quadraphonic sound simulated from 2-channel stereo originals is synthetic and it is really a matter of how you want to go about it. If the alternative of mechanically driven phase modulation takes your fancy, Leslie can provide the wherewithal to give it expression!

An interesting sidelight is the manufacturer's claim that the rotating system defeats the build up of standing waves in the listening room. Long term maybe, but would it stop single notes from exciting a room resonance mode? Here's ground for still more controversy.

For regular quadraphonic reproduction, the Leslie Plus 2 system reverts to a conventional role. A push button on the rear of the master cabinet switches off the phase modulation, both electrical and mechanical, and arranges the connections so that each system receives its appropriate rear left and rear right signal, as from a regular add-on decoder.

How does the system appeal?

As items of furniture, the cabinets are substantial and well finished, and appropriate for listening rooms where space is not a problem.

Mechanically, the rotating system is dead quiet and there is neither noise nor vibration to betray what is going on inside, when they are being used in this way.

Heard in isolation, the sound from the loudspeakers indicated a good average balance between bass, middle and treble, although internal design of the cabinet must prejudice the very lowest frequencies. But, as add-on systems, their general sound and lack of obvious colouration should allow them to merge with, rather than to dominate, existing installations.

In full simulation mode?

Here we had to opt out. While we were happy to listen to the speakers separately, probe into their mechanics and examine their drive waveforms, we simply didn't have the space to set them up for a meaningful test. And when we asked for volunteers to transport, uncrate, instal and listen to them in a typical private lounge room, there was a chorus of silence!

So, if you want to hear them for yourself, you had best go along to Rose Music Pty Ltd, or one of the distributors with the appropriate showroom space.

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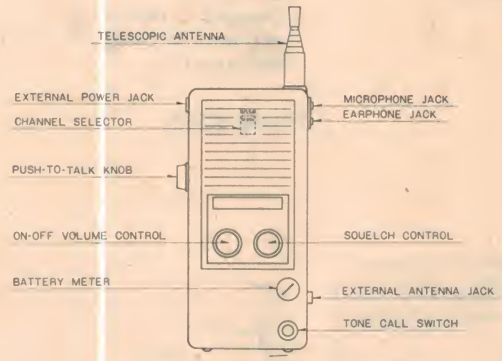

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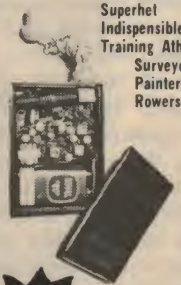

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Power requirements: AC 100, 110, 120, 127, 220 or 240V. **Tape speeds:** 19cm/s (7½ ips), 9.5cm/s (3¾ ips), 4.8cm/s (1⅞ ips). **Frequency response:** 20Hz-30kHz at 19cm/s. **Flutter and wow:** Less than 0.09% at 19cm/s. **Signal-to-noise ratio:** Better than 55dB. **Dimensions:** 418 (W) x 210 (H) x 392mm (D) (16½ x 8⅝ x 15⅞"). **Weight:** 11.0kg (24lb 4oz).

TC-458

The TC-458, an advanced stereo tape deck that's really feature packed. *Auto reverse recording. *Ferrite & Ferrite heads. *Closed-loop dual-capstan drive system. *AC servo controlled motor. *Mike attenuator. *2 FETS in preamplifier. *Tape tension regulator. *Line out volume control. *Roto Bi-lateral head system.

Power requirements: AC 100, 120, 127, 220 or 240V, 50/60Hz. **Tape speeds:** 19cm/s (7½ ips), 9.5cm/s (3¾ ips). **Frequency response:** With normal tape 20-25,000Hz at 19cm/s, With SLH tape 20-30,000Hz at 19cm/s. **Signal-to-noise ratio:** With SLH tape 56dB. **Flutter and wow:** 0.06% at 19cm/s. **Dimensions:** 401(W) x 410(H) x 201mm(D) (15⅞ x 16⅛ x 7⅞") **Weight:** 14.5kg (32lb)

TC-755

The TC-755, an impressive stereo tape deck that embodies all the required features for quality recording.

*Closed-loop dual-capstan drive. *3 ferrite heads. *AC servo motor. *10½" reel capacity. *recording buttons lock for recording in the absence of the user. *Line out volume control. *3 motors.

Power requirements: AC 110, 127, 220 or 240V, 50/60Hz. **Tape speeds:** 19cm/s (7½ ips), 9.5cm/s (3¾ ips). **Frequency response:** With SLH tape 20-30,000Hz at 19cm/s, With normal tape 20-25,000Hz at 19cm/s. **Flutter and wow:** 0.05% at 19cm/s. **Signal-to-noise ratio:** With SLH tape 56dB. With normal tape 53dB. **Dimensions:** 435(W) x 451(H) x 221mm(D) (17⅛ x 18¾ x 8⅛") **Weight:** 24kg (52lb 15oz).

SONY
for particular people

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SO7

Sony TC-152SD portable stereo cassette deck

Many hifi enthusiasts would like to own a stereo cassette deck with Dolby noise reduction and provision for chromium dioxide tape. Until now, these facilities were not available in a portable machine, but the new Sony TC-152SD fulfils this need.

In appearance, the Sony TC-152SD is not greatly different from any other good quality cassette deck except that it follows the recent trend to place all the main controls on the front panel instead of on the top panel.

Probably most people who buy this machine will seldom use it as a portable, but will just be content to have it as a high performance deck. But if you want to make high-quality Dolbyised recordings of live music in homes, halls and churches where a mains power point is not available, this is the only machine that can do it.

Measurements of the unit are 378 x 108 x 238mm (W x H x D) and weight is 5.4kg. A detachable carrying strap is provided.

Six levers, which include the Pause control and the Eject lever, control the transport mechanism. Unlike some decks, you can use the Eject lever to flip open the cassette well cover to view the progress of the tape. The levers have a firm, positive action which is easy to get used to.

A single amplifier and loudspeaker is incorporated into the unit for mono playback and monitoring during recording. In addition, you can monitor or play back the stereo signals via a set of stereo headphones at fixed volume level.

Two 6.5mm sockets are provided for low impedance microphones. Phono sockets are provided for Line inputs and outputs and these are paralleled by a 5-pin DIN socket. Vertical slider controls are provided for setting the recording levels.

On the top panel are four toggle switches for Dolby, Limiter, Bias (normal or Cr02) and metering signal selector.

One of the limitations of portable cassette recorders is that their modest supply rail, usually 6 to 7.5V, gives them only limited signal handling capability. It also makes it more difficult to arrange for constant current drive to the recording head which is desirable for best fidelity.

While the Sony TC-152SD still uses four carbon zinc cells to give a nominal six-volt supply, it gets over the problem of low voltage by using a DC-DC converter to give balanced supply rails of plus and minus 24 volts. Thus it has no signal handling problems at all and is better in fact than some exclusively mains-powered units we have tested.

The price for this solution is heavier battery consumption. Even with 4 D-size cells, Sony claim only 2 hours recording or 3 hours with their optional rechargeable battery pack. We think Sony are conservative in these claims, but there is no doubt that at an average current drain of about 350mA during recording the batteries will not last too long.

Of course, the TC-152SD will run directly from the 240V mains supply so that you are not always dependent on batteries. Strangely though, there is no socket provided so that the recorder can be used in a car via an adaptor or from a well-regulated external supply if you wanted to get the very best signal-to-noise ratio. The ability to be used in a car we regard as quite useful. We will have more to say later about signal-to-noise ratio.

Automatic cut-off is provided for the recording or replay modes, but does not apply to rewind or fast-forward. This is surprising in view of the fact that some other portable cassette recorders made by this company have automatic cut-off at end of tape for all transport modes.

While the current drain is lower than 350mA in the rewind mode — it ranges from 200 to 300mA — it rises to over 400mA at the end of tape. When you also consider the convenience of not having to standby the machine when it rewinds a C120 cassette, auto cut-off on all modes is fairly desirable, especially in a machine of this price range.

Continuous illumination of the recording level meters is only provided when the machine is powered from the mains and is in the recording or replay modes. When battery-powered in these modes the "Light" push-button must be depressed to obtain momentary illumination of the meters.

A similar button is provided to check the battery voltage. Both of these buttons are de-activated when the deck is not in use. This means that there is no chance of inadvertently discharging the batteries if one of the buttons is depressed while the machine is in transit or storage.

When the replay and/or recording levers are depressed there is a few seconds delay before the circuitry is fully activated by the DC-DC converter. This delay can be avoided by using the Pause button. This gives almost instantaneous tape take-up and click-free recordings.

Removal of the cassette compartment lid is easy and enables good access to the heads and capstan for periodic cleaning and demagnetisation when necessary.

The base of the deck is easily removed to reveal the internal workings. The well-screened power transformer is carefully oriented and mounted as far away from the replay head as possible. Most of the circuitry is accommodated on two large boards and while the inside of the machine is fairly crowded, the major adjustments (ie, preset pots) are easy to get at.

Sensitivity for OVU is quoted at 60mV. When we fed in this level of signal and set the recording level controls at maximum we found the VU meters reading about 2dB high. Nevertheless we used 60mV as the reference level as it meant the unit met its specifications for signal-to-noise ratio.

We measured record-replay frequency response at 20dB below OVU (60mV) using both low-noise ferric oxide tape and chromium dioxide tapes. Using ferric oxide tape of an acknowledged good-quality brand, the response was 30Hz to 10kHz within plus 1½dB and minus 3dB limits. At 12kHz, the response was 11dB down and plummeting. Repeating the test with Dolby switched in caused only a very slight deterioration in the response (1dB at 10kHz). This is not always the case in Dolbyised machines.

(Continued on Page 23)

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Audiosound Minuette II loudspeaker system

Audiosound Electronic Services have introduced a larger version of their successful Motette II which we reviewed in December 1973. Called the Minuette II, it is a two way system with dome tweeter and low resonance woofer.

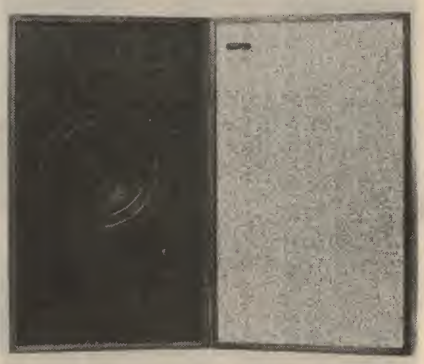
The Audiosound Motette II is a compact-sized shelf-mounting system measuring 280 x 465 x 235mm (W x H x D). It has a 25mm dome tweeter with a large ferrite magnet and a long-throw bass unit with an effectivecone diameter of 115mm. It too has a hefty ferrite magnet.

To ensure that low frequency performance is well maintained, the enclosure is tuned by a port 155mm and 50mm long. The internal volume of the enclosure is 21.6 litres (0.76 cu ft) and this is well filled with a coarse felt material for acoustic damping. The result is a rigid, very "dead" non-resonant cabinet which is desirable so that the cabinet does not add colouration to the sound.

Grille cloth is an acrylic scrim material glued to a frame which is a neat push-fit int the front of the enclosure. Colours available are Black, white, green, blue and gold. As we remarked in our previous review of the Audiosound Motette system, the use of acrylic scrim material is an excellent choice for grille cloth — it is acoustically transparent and is easily replaceable at low cost if it is inadvertently damaged or you want to change the colour.

Perhaps the most important feature of the Minuette is unseen — the cross-over network which operates at 3kHz. This has no less than sixteen elements; air-cored chokes, polyester capacitors and wirewound resistors.

Signal coupling to the woofer is rolled off at 6dB per octave below the cross-over frequency of 3kHz. Because the tweeter is apparently more sensitive than the woofer, it is fed via a fixed attenuator and thence via an 18dB/octave Butterworth filter with a "corner" frequency of 3kHz.



The term Butterworth is applied to second or higher-order filters (with slopes of 12 dB/octave or more) which have a very flat frequency response within the passband, good phase characteristics and a sharp "corner" characteristic. We gather that most loudspeaker designers seldom design their cross-over networks to give Butterworth characteristics.

In addition to the above the cross-over network also incorporates phase and impedance equalising components for both the tweeter and woofer. Hence, we should expect a very flat impedance curve? Right. We measured the impedance curve and found it remarkably constant and never drops below 6 ohms. Nominal impedance is 8 ohms.

Free-air resonance of the woofer is between 40 to 45Hz and in the enclosure it is tuned to give two very well-damped peaks (in.the impedance curve) at 70Hz and 30Hz.

Power rating of the Minuette enables it to be used with amplifiers with power outputs of up to 40 watts RMS. Indeed, if best results are to be obtained from it, the amplifier should be capable of at least 30 watts RMS per channel and have good damping factor at low frequencies. Naturally, Ausiosound are quick to recommend their own LD30 amplifier (reviewed December 1972).

Tested with a sine wave oscillator and high power amplifir we found the frequency response of the Minuette II system to be very smooth and without any obvious peaks or troughs. By comparison with the Motette it is less prominent in the upper treble region and has a better bass balance. Bass is well maintained to below 40Hz.

On music signals, the Minuette gives a very satisfying account of itself, clean and with no need for bass boost. And transient response is also good. For best results, it should be mounted on shelves or on a stand so that it is about 30cm off the floor and away from the corners of the room.

Conisdering the price of imported units against which it is competing, the recommended retail price of $196 per pair still seems quite reasonable. So if you want a pair of compact loudspeaker systems capable of really good sound, you could do a lot worse than consider these units from Audiosound.

All enquiries regarding these products should be directed to the manufacturer at the showroom, Audiosound Electronic Service, 148 Pitt Road, North Curl Curl, NSW 2096. (L.D.S.)

SONY TC-152SC From p23

While there is nothing remarkable about the response with ferric oxide tape, the chromium dioxide tape performance was very good, considering that it uses the same equalisation for both tape types.

We measured the response with Cr02 from 40Hz to 15kHz within plus 2dB and minus 2dB limits. At 18kHz, the response was 23dB down. Again, there was only very slight deterioration when Dolby was switched in.

With Dolby noise-reduction switched out we measured signal-to-noise ratio at minus 49dB unweighted. With Dolby switched the measurement was improved to 52 or 54dB depending on which channel was used. But to eliminate the last vestige of hum on recordings, batteries had to be used. This improved the signal-to-noise ratio to 54 or 56dB depending on which channel was measured.

A quick look back through our cassette deck tests indicates that the Sony TC-152SD is one of the best in regard to signal-to-noise ratios and frequency response. All this and portable too! One wonders what some of the other manufacturers have been doing.

In view of the fact that the TC-152SD does not have LED overload indicators we found the Limiter switch very useful. It performs very well and does not act at all until the signal rises above OVU. Above this, it can handle signals as much as plus 40dB above OBU with no trouble while still keeping distortion commendably low. The normal level of distortion for signals below OBU is between 1 and 2pc.

Separation between channels was good, ranging from 22dB at 10kHz to 40dB at 100Hz. Wow and flutter and speed regulation with failing batteries is also good with the electronically regulated DC transport motor.

We had a few niggles with the recorder in use. For one, it is susceptible to radar interference, although not markedly so. And the recording level controls have to be set at almost the lowest extreme when recording via typical stereo amplifiers.

Sony state that the deck must be mounted at least 30cm away from the amplifier or other mains-operated device to ensure that hum induction is not a problem. This is the case with most cassette recorders, but this is the first time we have seen a manufacturer make mention of it.

Coupled to a quality stereo system and used with Chromium dioxide tape and Dolby noise reduction, there are only subtle differences between first-class discs and tape copies of them.

Summing up, the Sony TC-152SD could well be the first choice of many people as the quality cassette deck for their stereo system. But with a couple of good quality microphones you can go out and make really first-class recordings almost anywhere.

Recommended retail price of the TC-152SD including sales tax is $399.

Further information on the Sony TC-152SD portable stereo cassette deck can be obtained from hifi retailers or from the Australian distributors of Sony products, Sony Kemtron Pty Ltd, 469-475 Kent Street, Sydney, NSW 2000. (L.D.S.)

News Highlights

Electronic sensors monitor coal mine conditions

For the first time in the history of coal mining, the concentrations of methane and oxygen, the presence of carbon monoxide, air flow and pressure changes, and the temperature and relative humidity of an active coal mine are being monitored continuously by a computerised electronic monitoring system.

Developed at West Virginia University's (WVU) Department of Electrical Engineering under the direction of Dr Melvin D. Aldridge, the new system is designed to monitor the onset of potentially dangerous conditions in coal mines in an effort to avoid some of the tragic accidents that have occurred in large coal mines in the past. Basically, it consists of a group of sensors placed at strategic locations, data relay stations and a digital computer at a central location. The computer has been programmed to process the data and determine when and where abnormal conditions exist, and to alert mine personnel.

Seven types of sensors are used in the system — one each for monitoring methane, oxygen, carbon monoxide, temperature, relative humidity, air velocity and pressure. The first five of these sensors are contained in a single package which is used in conjunction with the air velocity and pressure sensors. When a dust sensor that is compatible with the rest of the system is developed, it will also be incorporated into the system.

The sensors incorporated into the WVU system are as follows:

- a catalytic hot-wire sensor for measuring methane concentrations;
- an electro-chemical cell to monitor oxygen levels;
- a colormetric light transmission device to detect carbon monoxide;
- wet-bulb and regular electronic thermometers to measure temperature and relative humidity;
- a hot-wire anemometer to measure air velocity; and
- a transducer to measure air pressure.

For evaluation purposes, components of the system have been installed in WVU's Engineering Sciences Building and in the Federal No. 2 Mine near Miracle Run, West Virginia. The system has been in operation since November 16, 1972, and thus far no serious technical or operational problems have been encountered.

In addition to the sensor packages, a data relay station is located in the mine. Data from the sensors is relayed from the station by means of a telephone cable to the computer in WVU's Engineering Sciences Building. The relay station is a Bristol Datamaster Model 426 transceiver.

All of the sensors except those for air velocity and pressure are housed in a special box that has a pump and a filter. The pump draws the air into the box for testing, while the filter keeps the dust out. A pressure switch in the box indicates when the filter is becoming clogged. By turning off the pump, an operation which can be carried out remotely at the computer station, the dust falls off the filter and operations can be resumed.

Dr Melvin D. Aldridge (right) and two graduate students examine the computer readout derived from the new electronic coal mine monitoring system.

The only maintenance required for the sensors is to refill the water that is used in the wet-bulb thermometer and to change the colormetric disk that is used in the carbon monoxide detector — both about every six months.

The computer used in the system is a Digital Equipment Corporation PDP11/20. Several pieces of auxiliary equipment are also used. These include an analog-to-digital converter that enables barometric pressure and wind gusting measurements, which are carried out at the Engineering Sciences Building, to be incorporated with the other data.

In the test system, the computer readout is made through a standard teletype. Programs are now being developed to enable the computer to type out messages that would be readily understood by mine personnel. In future systems, a large mine map could be used to display measured data and, by using pushbutton controls, experienced mine personnel could easily be trained to operate the monitoring system.

Besides helping to prevent fires, explosions and other accidents, minute by minute records of conditions in a mine before an accident may enable the causes to be better understood, thus helping prevent future accidents of the same type. Furthermore, an analysis of daily and weekly changes in air resistance and methane liberation should also help mining engineers to plan future ventilation needs for a particular mine.

Other members of the WVU research team besides Dr Aldridge are Dr Walton W. Cannon, chairman of WVU's Department of Electrical Engineering; Dr Nelson S. Smith, who developed the electronic circuits for the sensors; Dr Robert E. Swartwout, who directs the computer programming; and Professor Donald T. Worrell, who was in charge of testing the sensors and who designed the unique filtering system for the sensor housing.

The research project is being sponsored by the US Bureau of Mines.

—George E. Toles.

Accelerometers for Mars Landers

The Bell Aerospace Division of Textron, Buffalo, New York, has completed a contract for the delivery of accelerometers for NASA's Viking Project. Thirty of the company's Model IX accelerometers have been built and delivered over the last 24 months.

The accelerometers, which are instruments that are extremely sensitive to changes in acceleration, will be used in the inertial reference unit of NASA's Viking/Mars Lander, an unmanned scientific spacecraft scheduled to make a soft landing on Mars in 1976. The instruments will be used in the Viking/Mars Lander to measure the atmospheric density of Mars, to control the landing retro engines, and to orientate the spacecraft during landing.

Paul L. Klingenmeier, technical director for the accelerometer program, said four Model IX units will be carried on each of two Viking Landers. The fourth accelerometer provides a redundant unit for the main thrust, or up-down, axis. Redundancy is essential to assure mission success as man-made correction commands cannot reach Mars in time to be useful.

The Viking Project has produced stringent environmental requirements for the Model IX. For example, each instrument must be capable of withstanding many hours of plus 128deg C sterilisation temperature exposures. Every part of the Viking Lander is sterilised before launch to assure that Mars will not be biologically contaminated by these remote unmanned exploration probes. —George E. Toles.

Computer pen inputs hand-printed data

A computer pen, initially developed at Stanford Research Institute (SRI), is to be marketed by a Sunnyvale, California firm, Xebec Systems Incorporated.

Trademarked Alphabec-70 by Xebec, the system utilizes a special ballpoint pen and recognition circuitry that translates hand-printed data into computer language, making it possible to enter hand-printed data instantaneously into a data processing system. In remote locations, the data can be recorded for later transmission to the data processing center. The first Alphabec-70 data entry systems to be manufactured will have 16-character capability (10 digits and 6 control symbols).

The pen system eliminates keypunching and all other keyboard-based procedures in data entry. It promises to expedite field data collection in such applications as utility meter reading and sales order entry by delivery routemen. It is also applicable to banking, telephone call logging, inventory control, and industrial data collection.

Xebec, a 5-year-old firm established to design and manufacture computer peripheral equipment and control systems, including moving head disks, flexible disk and magnetic tape systems, recently signed a licensing agreement with SRI for the development, marketing and sub-licensing of the system. The first systems will be ready for marketing by the first quarter of next year.

Electronic "ear" monitors heart defects

A minicomputer with a supersensitive "ear" is helping researchers at the General Electric Research and Development Center identify heart defects that can escape detection during routine electrocardiographic (ECG) examinations.

Although similar in principle to the stethoscope, the new technique can provide physicians with a much broader and more accurate range of heart sounds, all fully computer-analysed for on-the-spot interpretation and diagnosis. The data then can be accurately interpreted by family physicians and cardiac specialists alike.

The new GE technique, a form of phonocardiology, is designed to supplement rather than replace ECG examinations and is expected to be clinically qualified and ready for wide-scale application within two to five years. Once a serious heart ailment has been detected, the GE technique can also be used to evaluate its severity, thus reducing the need for complicated catheterisation procedures that require the injection of chemicals through tubes inserted into the heart.

Key to the new technique is a small electronic sound sensor which is placed directly on the patient's chest. The sensor detects sounds in the frequency range of one to 1,500Hz compared to the 30 to 500Hz normally "heard" with an ordinary stethoscope. These sounds are converted into digital signals, fed into a computer and analysed, and the results immediately printed out.

UHF TV transmissions within five years

A first step towards the future introduction of some television services in the UHF band has been taken by the Australian Broadcasting Control Board which has determined the channelling arrangements for UHF television.

The Chairman of the Australian Broadcasting Control Board, Mr Myles Wright, recently announced that the Board has issued a new edition of its "Technical Standards for the Australian Television Service". The revised publication (fourth edition June 1974) has become necessary in consequence of a recent Board determination that it would be necessary to introduce television services in the Ultra High Frequency band within the foreseeable future.

The UHF channelling arrangements, which have the support of representatives of the Australian television industry who were consulted on the question, envisage 32 new television channels, numbering 28-32 and 39-63 in the frequency bands 526-582MHz and 614-814MHz, and will supplement the existing 13 channels in the Very High Frequency (VHF) band. The non-continuous numbering system for the UHF channels arises from the desirability of arranging for uniformity between Australian channel numbering and frequency allocation and the present overseas (European) practice.

Mr Wright went on to say that the Board has not, as yet, authorised any broadcasting type services in the UHF band, but anticipated the need to do so for new types of television services — possibly in about five years time. However, within a shorter period, it was likely that the Board would be authorising UHF transmissions to supplement existing VHF transmissions for "fill-in" type services where existing reception was poor. Although 13 channels were originally provided, in accordance with the recommendations of the recent FM Inquiry, no new services will use Channel 5 in the future and many existing services on this channel will have to change to an alternative channel to make way for the introduction of FM broadcasting.

Mr Wright drew attention to the fact that the ultimate introduction of television in the UHF band will be influenced greatly by growth in the numbers of home receivers capable of UHF reception. "The Board has been discussing this situation with the television industry in recent months" he said, "and the introduction of colour television, which will cause the majority of viewers to replace their receivers within the next few years, presents a unique opportunity to create a substantial population of UHF equipped receivers". From its discussions, the Board understands that many colour television receivers now coming on to the market are either capable of UHF reception or can have the UHF channels added at a later date with minimum expense and without major modifications being necessary to the receiver.

CETIA 1974

Technological progress in many fields, coupled with computer management needs, will be covered at the 5th International Control Electronics Telecommunications Instruments Automation (CETIA) Exhibition and Convention which will be held from 7th to 11th October, 1974, at the Exhibition Buildings, Melbourne.

On show this year will be colour television equipment, electronics equipment and components, scientific and industrial instruments, process and pollution control equipment, communications equipment and computers.

NEWS HIGHLIGHTS

AWA colour orders reach $12 million

Orders for colour television equipment secured by AWA in Australia and New Zealand have so far totalled more than $12 million. These orders include 120 Mark VIII colour cameras, ten outside broadcast (OB) colour television vehicles, and a wide range of studio equipment.

AWA (New Zealand) Ltd, acting on behalf of Marconi Communications Systems Ltd has won a major share of orders placed by the New Zealand Broadcasting Corporation for television equipment for the Dominion's colour service. So far, orders have been received for three OB vehicles, each with four Marconi Mark VIII colour cameras. Two of these have already been delivered to the Corporation, and were the mainstay of the Corporation's colour programming for the Commonwealth Games.

To date, a total eighteen Mark VIII studio cameras have been sold in New Zealand together with two integral auto-telecine machines. The telecines have been installed and six of the 18 cameras delivered.

It is also worth noting here that AWA is now marketing the recently released portable version of the successful Mark VIII camera. The new unit, pictured at right, is designed for either hand-held or tripod applications, and retains the Mark VIII features of automatic alignment and

automatic colour balance. In addition, the unit can be connected to a standard Mark VIII camera control unit.

The camera head contains the optical assembly, three one-inch lightweight scanning yokes, and four printed boards containing the necessary scan circuits, tube supplies and amplifiers. The head is connected to an auxiliary pack via a 13mm diameter cable up to 50 metres long. In operational conditions, the auxiliary pack may be carried in a harness by either the cameraman or his assistant.

Quartz crystal watch has LCD readout

A new range of solid state digital watches with liquid crystal displays has recently been introduced to Australia.

Designated the "Minipet Exetron," the new watches are fully solid state and have no moving parts. They are timed by a 32,786Hz quartz crystal operating in conjunction with a single CMOS integrated circuit performing the required frequency divisions.

The liquid crystal display provides good readability in all light conditions whilst minimising current consumption. The unit is powered by a 1.5V silver oxide cell which lasts for approximately one year.

Minipet is represented in Australia by Landshire Industries who are located at the Park Regis, Suite 272, Park St, Sydney.

New computer memory uses optical techniques

According to NASA's Dr Bernard Rubin, scientists at Battelle Memorial Institute's Columbus, Ohio, laboratories are now perfecting a technique for NASA that could lead to more compact and reliable data storage systems in computers. These would be superior to those now available using electrical and magnetic memory systems.

The new technique uses organic materials whose chemical reactions can be manipulated by low-power lasers to produce phase holograms. Phase holograms are optical image-storing units created as a result of a chemical reaction to selected laser light wavelengths. Each hologram will hold 100 million pieces of information per square centimetre.

Besides increasing storage capacity, the new technique will be more economical because the organic materials used are cheaper and more readily available than conventional inorganic optical materials. Furthermore, the energy required for forming holograms is considerably less than that needed for memory systems in conventional computers, permitting the use of compact, economical, and reliable lasers.

The practical implementation of the concept, based on optical rather than conventional electrical or magnetic techniques, appears to promise high-density memories, with the added advantage of a minimum of moving parts.

Torrid test for Helios prototype

Parts of a prototype Helios spacecraft reached a blistering 370deg C (700deg F) during recent tests in the 8-metre space simulator at NASA's Jet Propulsion Laboratory (JPL), Pasadena, California. The German-designed spacecraft withstood six days of testing, and was proclaimed ready for the extreme temperatures it will encounter during an unprecedented journey to within 45 million km of the Sun.

The simulated solar radiation which Helios survived in the JPL vacuum chamber was equivalent to 11 times the solar intensity at the outer edge of the Earth's atmosphere, and is referred to by space scientists as "11 suns." This intensity is the highest achieved in the JPL space simulator to date, the previous high being of the order of 6½ suns, which was achieved during tests on the Mariner 10 spacecraft prior to its successful trip to Mercury earlier this year.

The solar simulation tests are accomplished by employing a battery of xenon-gas arc lamps whose combined light output is directed through a focussing lens and onto a 5-metre collimating mirror, from which it is reflected into the test area and onto the spacecraft. The Helios prototype was spun at a rate of 60 revolutions per minute during the tests, simulating the procedure adopted to keep the spacecraft from burning up as it nears the Sun.

The first Helios spacecraft, Helios A, is scheduled for launching from the Kennedy Space Center in late October, 1974. A second craft, Helios B, is scheduled for launch in late 1975.

NASA launches new weather satellite

For the first time, transmission of day and night pictures from synchronous orbit is planned from a NASA weather satellite which has just been stabilised in an orbit over the equator at 45 degrees west longitude.

Previously, NASA's most advanced weather spacecraft could transmit weather pictures by day or night, but their inclined orbits precluded the continuous, uninterrupted transmission which is now possible with Synchronous Meteorological Satellite-1 (SMS-1).

SMS-1's first assignments are to return cloud cover photos and transmit other data in support of an international investigation of weather in the Earth's tropical belt. Following these investigations, the satellite will be moved to 70 degrees west longitude to become part of an operational system of the National Oceanic and Atmospheric Administration. Operating in this role, the satellite will provide continuous observation of the United States and adjacent ocean areas.

SMS-1 was launched from Cape Canaveral, Florida, on May 17, and, although initially placed in a lower orbit than expected, it was subsequently manoeuvred by on-board hydrazine gas jets to the required altitude of 35,786 kilometers (21,471 miles) over the equator. From this perch, keeping speed with the rotating Earth underneath, the spacecraft has been returning excellent pictures of the Western Hemisphere every 30 minutes.

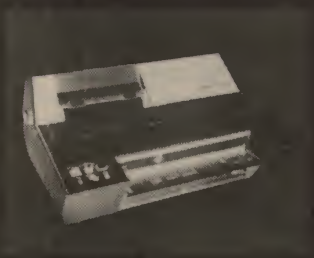
Australia

Plessey knife and fork connectors are part of the wide range of multi-circuit connectors marketed by Plessey Australia, Components Division. They are available in standard 20, 40 and 80 way sizes.

Internationally recognised "RACINE" hydraulic pumps and valves are sold and serviced throughout Australia by Plessey Australia, Telecommunications Division, Meadowbank, NSW.

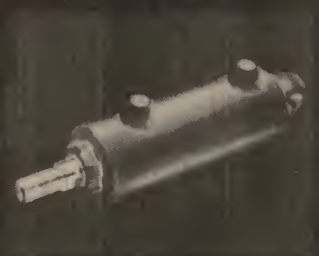
These NEC solid tantalum capacitors are designed for decoupling, by-pass, blocking and filtering applications in both professional and domestic electronic equipment. They are but one of the extensive range of professional components available from Plessey Australia, Components Division.

Illustrated is the MRT 40 mobile 2-way radio system with an SC 201 Decoder fitted. Developed by Plessey Australia Electronics System, Richmond, Victoria, the system employs a method of selective calling whereby each operator receives only those messages specifically directed to him.



Marketed by Plessey Communication Systems, the Facsimile Remote Copier is a desk-top copier capable of transmitting and receiving over public or private telephone lines, printed, written or graphic material within minutes.

This radio paging miniature receiver uses the most advanced electronic circuitry to maximise efficiency in the location of staff. This inductive loop system is available from Plessey Communication Systems.



Designed and manufactured locally, Plessey hydraulic cylinders and presses are available for a variety of industrial and mobile applications. The cylinder illustrated is just one of the wide range available from Plessey Australia, Telecommunications Division, Meadowbank, NSW.

Marketed by Plessey Australia, Components Division the 'Magispark' is a compact electronic gas lighter providing a continuous spark suitable for use in kitchens, on boats, caravans and for outdoor stoves and gas barbecues.

Number of plants: 8
Factory capacity: 1 million sq. ft.
Employees: 4,000

Plessey

APP70/R1

Pollution-free vehicle runs on stored heat

With increasingly strict governmental regulations on vehicle emission levels, and the need to conserve our dwindling supply of fossil fuels, the race is on to develop viable alternatives to the internal combustion engine. This article discusses one new engine currently under development. It is powered from a source of stored heat, and is pollution and noise free.

by DAVID SCOTT

Take an engine that runs on heat derived from any source — gasoline, oil, steam, the sun — and couple it to a new kind of heat storage device that has recently been used, among other things, to store solar energy for home heating. The result is a new automobile engine that seems to be the best combination of all possible worlds.

It's as quiet, clean, and vibration-free as an electric vehicle, but has the "pep" and range of a conventional gasoline-powered car. And it's not just a theoretical concept. At Philips Research Laboratory in Aachen, Germany, I recently saw half of this remarkable system: a thermal sponge that can be slotted into a car in place of the petrol tank and hold enough energy to drive a car for hundreds of miles. And in Eindhoven, the Netherlands, I saw the other part: a Philips swashplate Stirling-cycle engine.

The whole idea, of course, is strictly experimental. But this dark-horse combination could become a front runner in the race to build an economic no-pollution car.

The concept of storing energy for subsequent use is hardly new — the electric battery embodies this principle. However, for use in a car, a power source must meet some quite stringent requirements: it must be light and compact, have a large capacity, and be capable of rapid recharging. Philips researchers figured heat storage could be the answer.

Their starting point was to find a substance with a high melting point and utilize the high heat of fusion. This occurs at the eutectic point, the precise temperature at which the solid and liquid states of a substance can exist alongside each other. That temperature is constant, just as in a glass of ice water until the last speck of ice melts. Latent heat is given up at this point, and can be drawn off in large quantities until the material solidifies fully and the temperature starts to drop.

The search narrowed down to fluorides of lithium, sodium, and magnesium, which have higher heat capacities than any other known compounds. One substance tried is a mixture of lithium and magnesium fluorides, which has a eutectic melt point of 746deg C and a higher heat of fusion per unit weight than the other salts.

Its energy storage capacity is phenomenal. The effective energy it can store in terms of kilowatt-hours is about 10 times that of a lead-acid battery per unit weight and volume. That means faster road speeds than with an electric car, and a far greater range on one charge. While lithium is a rare and expensive element, its content in the mixture can be kept to about 10 percent by weight to keep cost down. Alternatively, cheaper materials, such as fluorides of sodium and magnesium, could be used.

The lab model heat tank I saw at Aachen

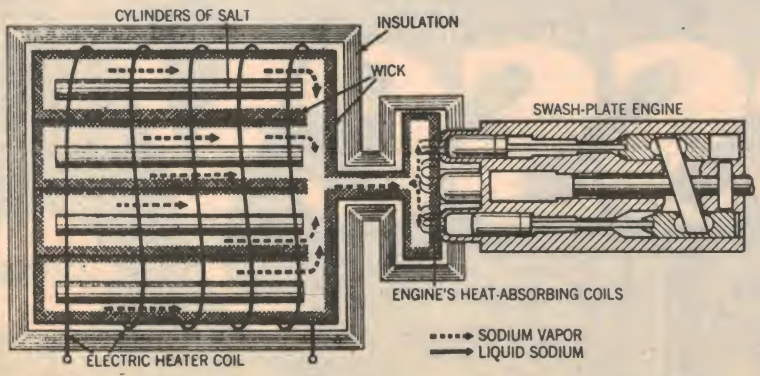
The molten-salt heat storage unit shown under test at the Philips Research laboratory, Aachen.

(originally designed as a space heater) is a yard-high stainless-steel cylinder with a tubular electric resistance element suspended in the centre. To charge it up you switch on the central immersion heater until the core melts, and you've got potential energy on tap. Heat losses are prevented by first wrapping the container in several layers of metal foil, spaced apart to avoid thermal contact.

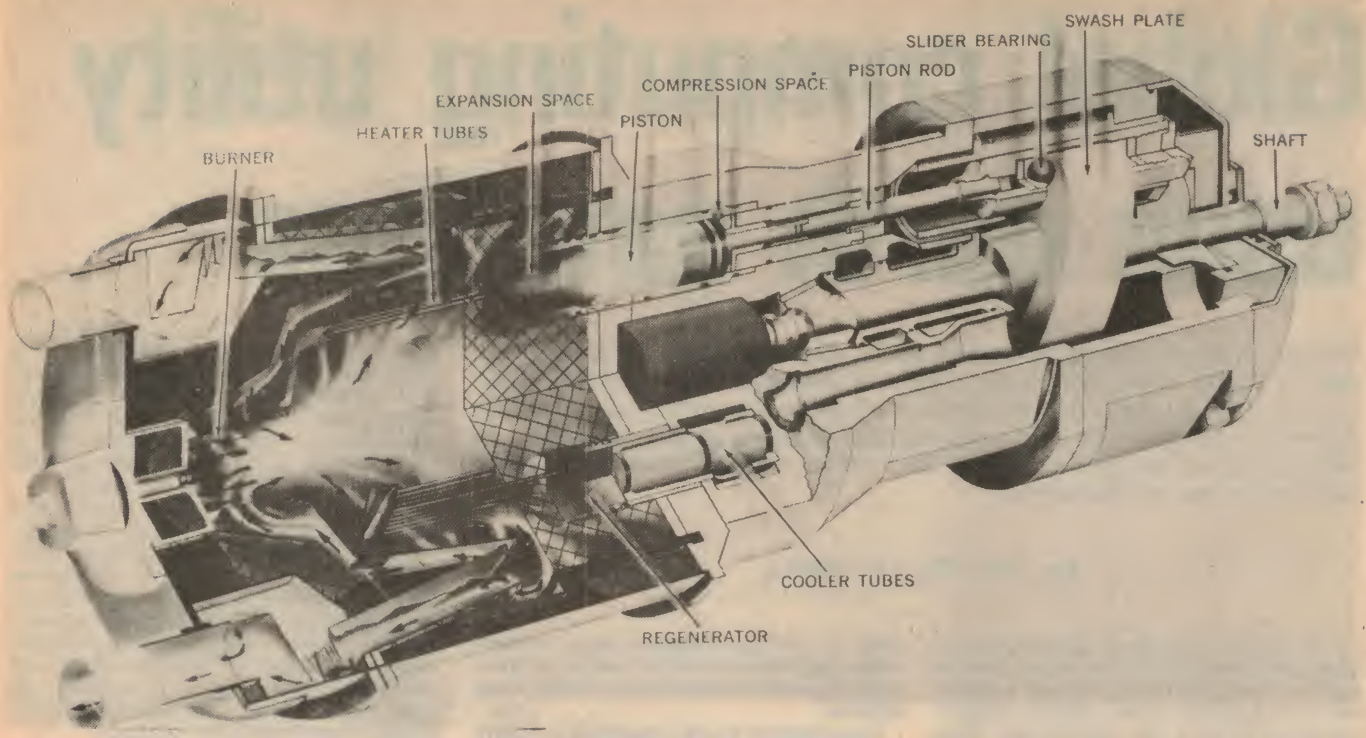
The assembly is then enclosed in a close-fitting outer vessel. As in an ordinary thermos flask, air in the interspace is evacuated to stop convection.

The insulation in the automotive version can keep the salt hot for one to three weeks, according to Philips — far longer than necessary for most uses. Charging time will run from one hour to overnight, depending on the wattage of the heating element and the current available. When speed is essential, the unit could be designed for heating up by a torch-like flame, which

Combining two new technologies: Stirling engine plus molten-salt heat storage



This line drawing illustrates the basic concept of the stored heat Stirling engine. Heat to run the engine is stored in a sealed cylinder of molten salt and is transmitted through a heat pipe to the engine as follows: The cylinders of molten salt heat liquid sodium in the chamber, turning it into vapour. This vapour moves down the pipe and gives up its heat at the engine, condensing into a liquid again. The liquid sodium is absorbed by a wick which lines the heat storage and transmission spaces, and flows by capillary action back to the storage area where the cycle is repeated. The engine is "refuelled" by reheating the molten-salt cylinders electrically. Later models may incorporate fuel-fired heaters to enable faster recharging.



This burner-powered version of the Philips swashplate Stirling engine runs on any liquid fuel, produces few pollutants, and is almost vibration free. In the version now under under development, the burner will be replaced by a molten-salt heat storage unit.

might take only 10 minutes. The heat is transferred from the molten salt to the engine via a heat pipe, a remarkable device that can transmit 10,000 times as much heat as a copper rod of the same size.

The method for turning off the heat flow to the engine has not yet been decided. But various methods could be used. For example, a chamber built into the heat pipe could be alternately filled with hydrogen — which transmits heat very efficiently — or evacuated to serve as a heat switch. Such a system is in use on the laboratory heat-storage system I saw in Aachen. Instantaneous torque changes are controlled easily: to make the engine stop, simply lower the pressure of the working gases in the cylinders.

Back at Eindhoven, Dr R. J. Meijer, leader of the Stirling Research Group, showed me one of the engines humming away on a test bed. Designed for the Ford Torino, it was running on diesel fuel. The quietness was incredible, the only sound being a subdued moan from the burner blower.

Since there's no crankshaft on the swashplate engine, as on the older rhombic-drive designs, there are no gears to whine and the bearing forces are sliding rather than oscillating. With continuous combustion there are no explosions, so no muffler is necessary. The heat store is still some way ahead, but it will make the engine virtually silent as well as pollution-free.

Dr Meijer's team started work on this concept in 1968, and three of these 60-hp engines, each with a total displacement of 264cc, have now been built. Together they have run up well over 3,000 test-bed hours and, since the Ford agreement of August 1972, have provided valuable data for the development of a 170-hp unit. The first prototype is currently undergoing dynamometer testing at Eindhoven.

This new Stirling will have a gasoline-fired burner so that direct checks on fuel consumption against a conventional Ford Torino V8 can be made, and refuelling on the road can be simplified. According to computer projections the Stirling has a clear edge on economy, with an average of 14.7 mpg in a Torino compared to 12.7 (10.7 with emission controls) for the base V8.

Ford wants to match the performance of the petrol engine, so the two companies have developed a control system to give the same acceleration. The Stirling's throttle arrangement is like nothing else. Head temperature is kept at a constant 750 deg C, and power is regulated by varying the working pressure of the gas in the closed circuits.

But simple releasing of gas into an external reservoir and then pumping it back to change the speed would be too slow. So engineers have developed a system with a reserve of extreme-pressure gas stored in a small bottle. Valves discharge this gas instantly into the working circuits when you hit the throttle, and return it just as fast when you ease off. Reaction time from idle to full torque is no more than a tenth of a second.

Other development work has been on the tricky geometry of the swashplate, bearing-pad material, lubrication, and design of the heater cage. Water-cooling the Stirling has presented special problems because all of the closed-cycle gas heat has to be dissipated by the radiator — there is no exhaust in the stored-heat engine to carry part of it away as in an internal-combustion engine. So Philips has designed a "folded-front" radiator with over twice the dissipation rate of a conventional radiator.

In concept, then, the new engine looks promising as a viable alternative to the present internal combustion engine, and could form the basis of future generations of cars. However, much research work remains to be done.

Dr R. J. Meijer of Philips examines the major components of the Swashplate engine. The heater cage is also shown, situated on the table behind the engine. The unit in the background is a 60HP Stirling engine used as a basis for the design of an engine for the Ford Torino.

Reprinted from "Popular Science," by arrangement.

Global computing utility uses earth satellites

The launching of advanced communications satellites into synchronous earth orbit in recent years has placed a new emphasis on the "global village" concept. It now seems that the concept of global computing, with satellites providing a link between vast computer centres and overseas terminals, will become part of this new emphasis. This article discusses one such system currently in use by Honeywell.

by DAVID FRENKEL

In an effort to convey the future effects of high speed international communication on a global scale, Canadian professor Marshal McLuhan used the term "global village." Honeywell's Mark III international computer utility embodies this concept today. From computer terminals in a large number of countries around the world, and for the price of a local call and computer utility time, one can gain access to Honeywell's computer facilities at their "super centre" in Brook Park, Cleveland, Ohio.

You dial up in Sydney (or Melbourne) to place sales orders into your company system and your warehouse in Germany (for example) might receive an inventory requisition generated by your stock control system. Perhaps your central management is in London. They, at any time of the day, can dial up and check the progress of the firm on an international basis without suffering the overhead and time lag of other international information transmission systems.

The concept of global computing is utterly staggering in its implications. Whereas most firms cannot afford complex international hookups to monitor company performances (only giants like PAN AM and General Motors really can), the Honeywell Mark III system will provide quite small companies with the ability to monitor their operations on a day to day basis.

When you dial up the service in Australia, you are connected through a number of circuits to OTC in Paddington, Sydney, which then transmits the information by ground line to OTC's communications satellite station at Moree, NSW. This in turn transmits the information via Intelsat IV to a dish at Jamesburg, California, and from there on to the Honeywell computer centre at Brook Park. The current link has a data transmission rate of 7,200 baud, or about 1,200 characters per second. This figure is to be increased in the near future to 9,600 baud, or 1,600 characters per second.

This type of utility supports a number of general purpose programming languages, such as FORTRAN (FORmula TRANslation), BASIC, COBOL (Common Business Oriented Language), and ALGOL. The sophistication of programs capable of being run from a simple office terminal is almost unlimited. In fact, the Honeywell terminal system would outrank, in flexibility and power, the vast majority of in-house installations in Australia.

The system offers a wide range of existing ready-to-use software packages (programs) for every conceivable facet of computing. These include a large number of packages for subjects such as engineering, financial analysis, mathematics, project planning and statistics. In order to gauge some idea of the scope that these packages cover, it is worth noting that a library software index is available from Honeywell, and this would be a worthwhile reference to keep on hand in any business environment.

For the electrical engineer, many varieties of software packages exist. For example, one program, designated CIFLO, will perform load flow studies of electrical power systems incorporating up to 100 buses and 400 lines. Another package, designated ARRAY, calculates antenna patterns for linear arrays of radiating elements.

One software package that should be of considerable interest to electronic circuit designers is known by the code name ECAP. This package performs complete AC, DC and transient analyses of electronic circuits, allowing simple substitution of new component values and tolerances for "bread board" evaluations of circuit performance. In order to illustrate the use of the ECAP software package, we will consider a simple example.

Above is OTC's communications satellite station at Moree, NSW, which is responsible for relaying the computer data to the United States via INTELSAT IV.

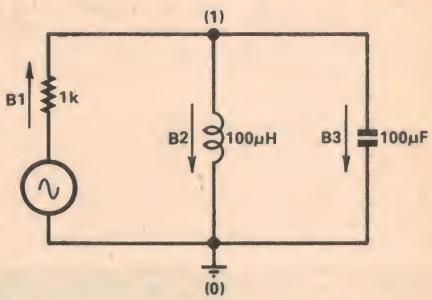
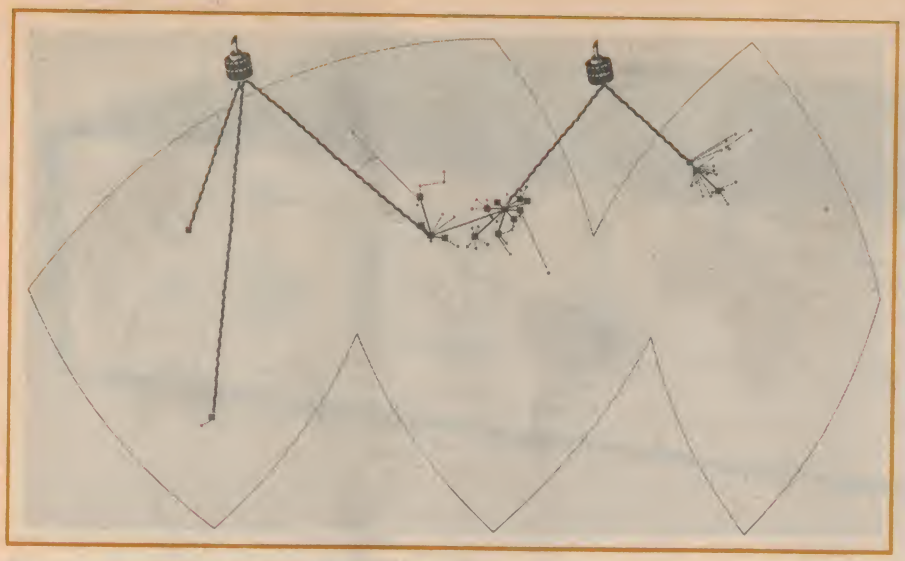
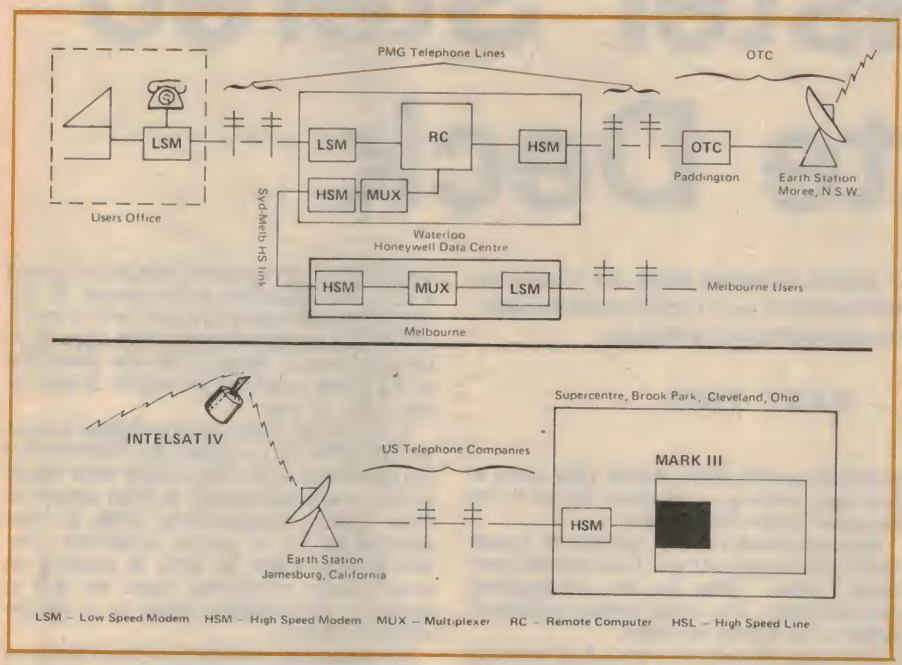


Fig 1 (above) shows the simple LCR circuit used in the example given below.



The current worldwide extent of Honeywell's international computer service may be gauged from the diagram above. The diagram below depicts the maze of circuits involved in Honeywell's data link from Australia to the United States.



The circuit shown in Fig 1 is a simple LCR arrangement consisting of a 10V AC voltage source in series with a 1k resistor and a 100uH inductor paralleled by a 100uF capacitor. To analyse the above circuit (ie, to find the current flowing in the circuit and to find the voltages at the node points (1) and (0)), the following instructions are issued to the ECAP program:

```
1030  AC ANALYSIS
1060  B1,N(0,1),R=1000,E=10
1070  B2,N(1,0),L=100E=6
1080  B3,N(1,0),C=100E=6
1090  FREQUENCY=1000
1100  PRINT,VOLTAGES,CURRENTS
1120  EXECUTE
1125  MODIFY
1130  FREQUENCY=2000
1140  EXECUTE
```

Just what these various instructions mean is as follows:

Line 1030 states the type of voltage source applied;

- Lines 1060, 1070 and 1080 describe the 3 branches of the circuit where N(x, y) locates and identifies the nodes;
- Line 1090 states the frequency of the voltage source (1kHz);
- Line 1100 is a request to print the resultant voltages and the current;
- Line 1120 instructs the computer to perform the abovementioned instructions;
- Lines 1125-1140 alter the frequency parameter and instruct the computer to recompute the result.

Should the user so desire, this program may be suitably modified to perform DC analysis or transient analysis.

In conclusion, it is worth noting that suitcase model terminals are now available in Australia, enabling you to take your work home, plug in, dial up and compute to your heart's content. The computer revolution could promote the breakdown of even the happiest marriage if it continues along these lines.

Circards: Series 2-11 available

Readers who obtained a copy of the first set of these a valuable aids to circuit design will no doubt be interested to learn that we have finally been able to obtain limited supplies of the later sets, namely series 2 to 11 inclusive.

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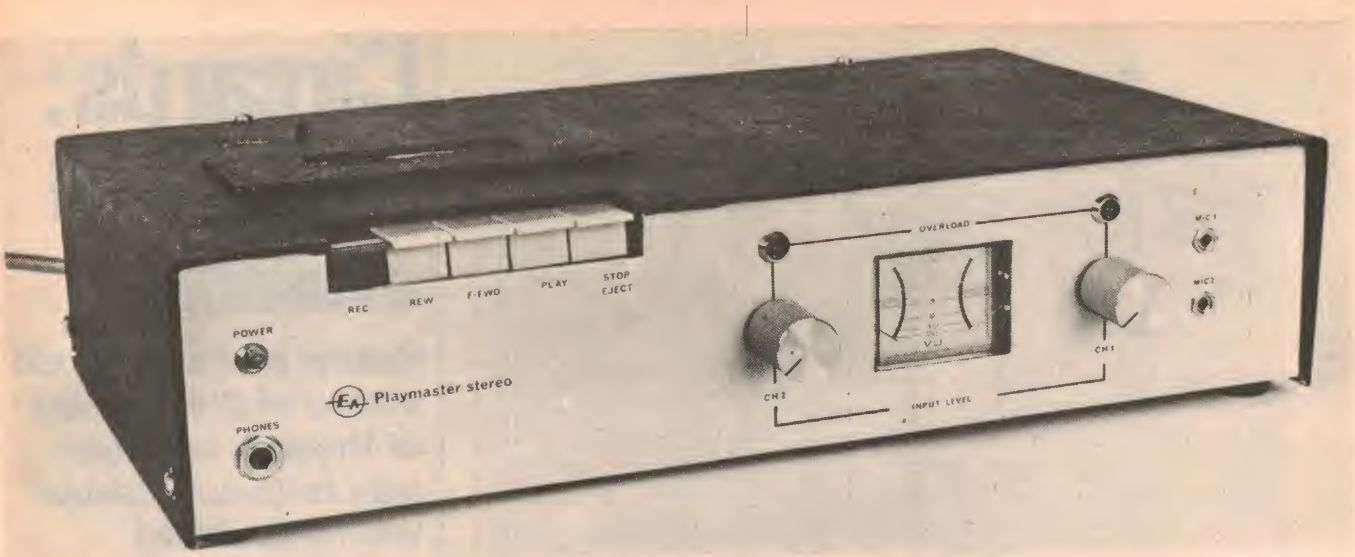


Playmaster Stereo Cassette Deck

In this second article on the Playmaster stereo cassette deck we continue description of the circuit, give details of performance and modifications made since the August article and supply all the construction information.

by LEO SIMPSON — PART TWO

In the specifications panel is a summary of the performance of the Playmaster stereo cassette deck, and some explanation of the figures given is probably desirable. The frequency response is quoted at a signal level of minus 20VU, at within plus or minus 3dB from 80Hz to 9kHz. This represents an "average" of record-replay response curves taken from various low-noise ferric oxide tapes.

The frequency response is further illustrated in graph form on these pages. As such, while it is not marvellous compared with the best that can be obtained from expensive machines, it still represents a creditable performance from this deck. Commercial machines having this sort of performance would typically be rated as having a response from 50Hz to 10kHz, with no limits specified. With the Playmaster deck, at least you know what you are getting.

Note that we have quoted a signal level minus 20VU for the frequency response measurement. This is standard practice. Testing at higher levels can cause problems with tape and head saturation because of the high frequency pre-emphasis. Some manufacturers make their test at signal levels as low as minus 30VU.

In the replay mode, the frequency response can be expected to be somewhat better than is indicated in our figures for record-replay. We hesitate to quote figures though, because they cannot be verified by potential constructors unless they have a test tape made on a machine known to be superior to the Playmaster.

Signal-to-noise ratio is quoted as minus 42dB with respect to OdB, from typical low-noise tapes. This is an unweighted measurement, i.e., it represents wideband noise — no filters are used.

Harmonic distortion is quoted at between 1 and 2 pc. This is an average level for typical recordings. At OVU harmonic distortion is around 4 percent, which is a typical figure for medium quality cassette machines.

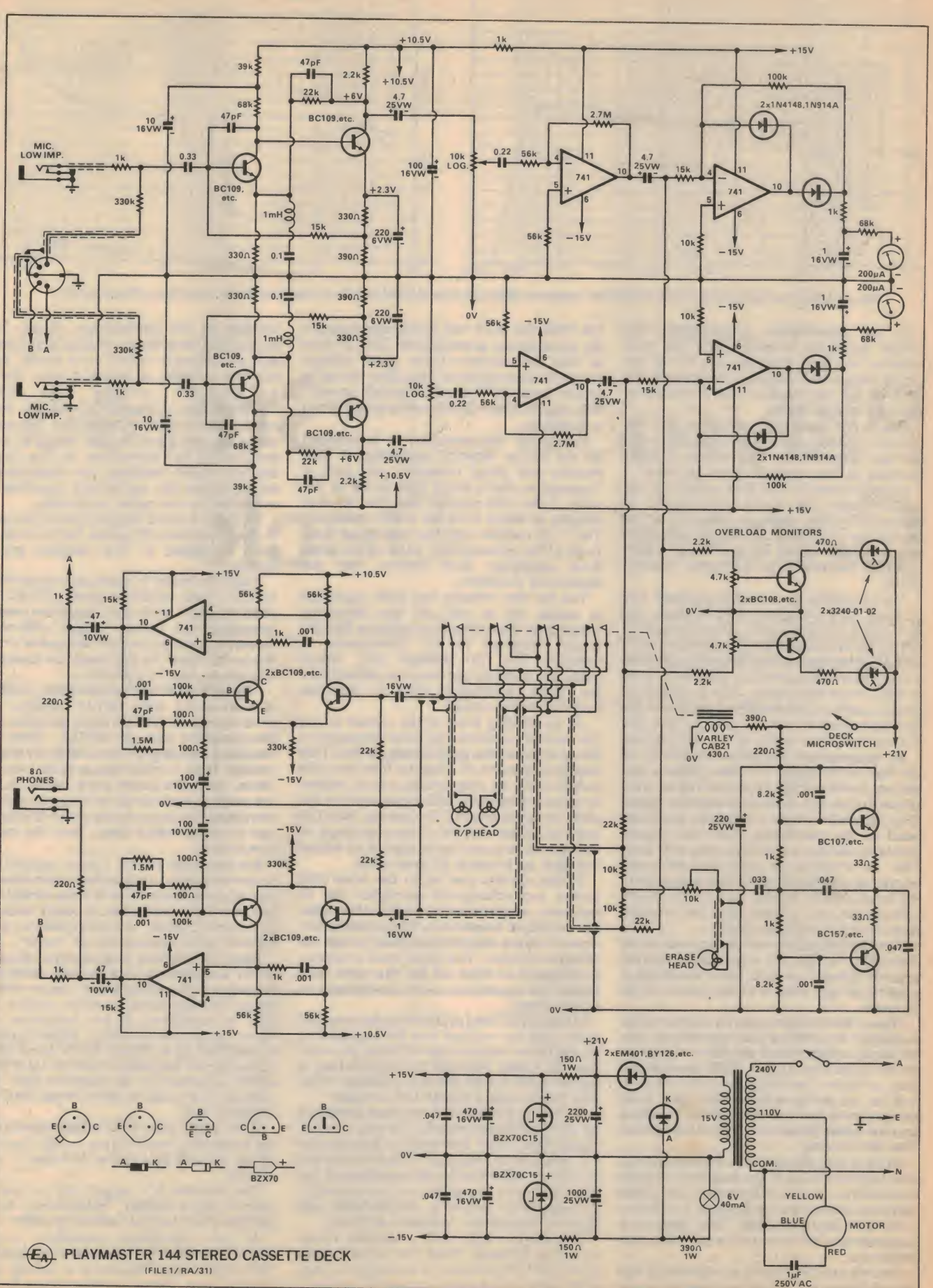
Incidentally, although the harmonic distortion of the cassette deck is as quoted above, the distortion performance of the recording and replay circuitry is very much better and is typically less than .05pc over the whole audio range. Even the distortion of the erase oscillator waveform is only of the order of 0.4pc.

A statement made in the August article now needs to be qualified. We claimed that the steel case of the Playmaster deck would render it not susceptible to hum induction from power transformers when it was stacked on top of power amplifiers. Unfortunately, when the deck is stacked on most stereo amplifiers, hum is still a problem. Fortunately, there is a simple solution: Don't!

Several modifications have been made to circuitry since the circuits featured in the August issue were drawn. These mods are incorporated in the complete circuit. Briefly, they are as follows: Capacitors originally specified at 56pF are 47pF, which is a manufacturers' preferred value.

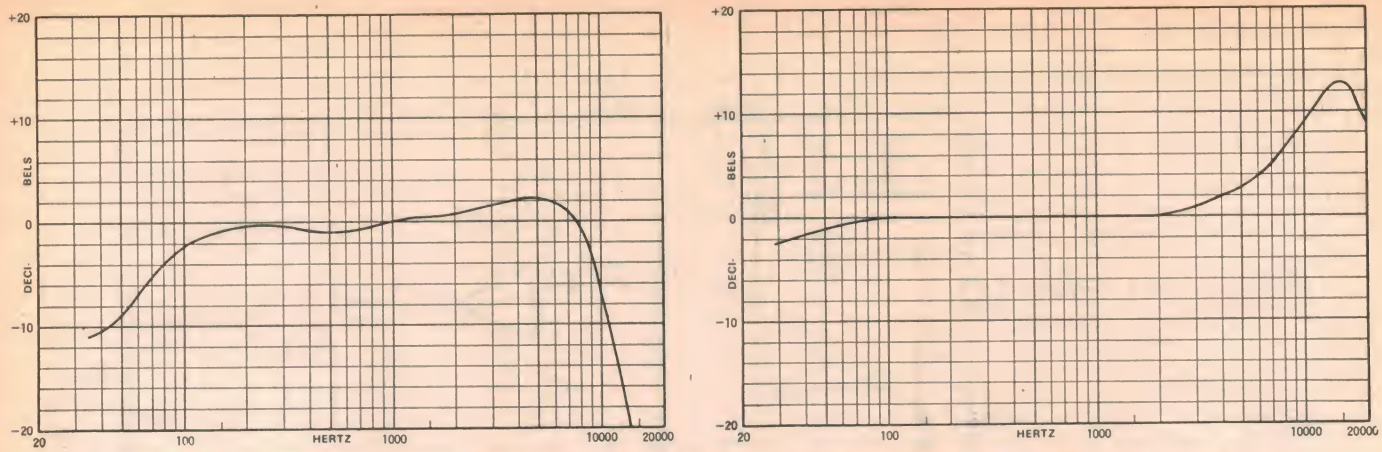
SPECIFICATIONS:-

Tape speed: 4.75cm / sec
Wow and flutter: less than 0.3 pc
C60 rewind time: 90 to 100 seconds
Motor type: Synchronous induction
Heads: 1 half track erase; 1 stereo ¼ track record/playback.
Frequency response: Record-play response at minus 20VU is from 80Hz to 90kHz within plus and minus 3dB (see graph).
Signal-to-noise ratio: Minus 42dB with respect to OVU (unweighted).
Separation between channels (cross-talk): Better than 30dB over the range 100Hz to 10kHz.
Sensitivity: Line inputs, 120mV into 330k for OVU. Overload capability greater than 10V rms at 1kHz. Mic input 200uV; suitable for any low impedance microphone.
Erase frequency: 70kHz; Erase voltage 17V + 1V.
Erase ratio: Better than 50dB.
Record head bias: Constant current audio; 8V bias.
Output level: 0.775V at OVU; average output 100mV rms. Output impedance, 1k.
Harmonic distortion: Between 1 and 2pc (see text).



PLAYMASTER 144 STEREO CASSETTE DECK

(FILE 1/RA/31)



Above left is the record-playback frequency response taken at minus 20VU while to the right is the recording characteristic.

In the equalisation preamplifier, the 0.27uF capacitor in series with the 1mH inductor has been reduced to 0.1uF to optimise the overall response. This moves the peak in the equalisation characteristic to between 15 and 16kHz.

And in the metering amplifiers, the 10k and 82k resistors have been changed to 15k and 68k respectively. This effects a slight increase in the nominal recording level.

As mentioned in the first article in the August issue, the replay preamplifier is substantially the same as featured in the November 1973 issue. For those who have not seen that article we shall now briefly describe the circuit of the replay preamplifier.

A preamplifier for cassette playback has to meet very stringent requirements, the first being adequate gain. Measurement of the signal available from the playback head of the Vortex deck shows that no more than a few hundred microvolts is delivered, even at high recording levels. This is typical of stereo cassette decks and is a function of the low tape speed of 4.75 cm/sec (1/ips) and the narrow track width of 0.3 millimetres.

By comparison, the input sensitivity of the high-level inputs of most modern amplifiers is of the order of 100 millivolts. If we assume that the typical minimum signal level available from a cassette playback head is 100 microvolts, then the preamplifier should have a voltage gain of at least 1000. In addition, it must provide compensation for the fall-off in bass response of the head, which means that at the lower frequencies, i.e., around 50Hz, the required gain is of the order of 10,000.

Even an operational amplifier such as the Fairchild uA741 or equivalent cannot provide this sort of gain, after feedback is applied. In any case it is too noisy for the purpose.

These two problems can be solved rather elegantly by driving the operational amplifier by a differential amplifier consisting of two low-noise silicon NPN transistors. This provides the additional gain required and in so doing ensures that the noise performance of the circuit is determined by the low noise transistors, which are better than the op amp.

Refer now to the circuitry of the playback preamplifier on the main diagram. The two transistors in the differential amplifier (driving the op amp) each run at a collector current of just over 20uA. This figure is a compromise between gain and noise performance.

The 56k resistors used as collector loads for the differential amplifier transistors are run from the 10.5V rail which also supplies the equalisation preamplifier. This is done so that the common mode input voltage rating of the operational amplifier (which is plus or minus 12V) is not exceeded. As well, this supply is heavily filtered to keep hum to a minimum.

Frequency compensation is determined by the series network consisting of 100k resistor and .001uF capacitor, and gain at frequencies above about 1kHz is set by the ratio of the 100k resistor and the 100 ohm resistor in series with the 100uF capacitor. The 1.5M resistor sets the maximum bass boost of the preamplifier while at the same time supplying bias current for the associated transistor.

The 100 ohm resistor and 47pF capacitor in series act to roll off the frequency response in the supersonic region so that the circuit response to RF interference is reduced. The 1k resistor and .001uF capacitor in series between the collectors of the input transistors acts to improve stability of the circuit.

An interesting facet of the circuit is the 15k resistor connected between the output of the op amp and the positive supply line. This causes a current of 1mA to flow into the output of the op amp and so acts to reduce cross-over distortion, which can occur in the class-B output stage of the op amp. With this order of output current, the output stage of the op amp is operating in class-A at output voltages up to about 2V peak-peak.

Output signals are fed to the 5-pin DIN socket and subsequent amplifier via 1k resistors, which provide a reasonable value for the output impedance. The preamplifier also drives the stereo headphone socket via 220 ohm resistors. The signal level available is adequate to drive all but the most inefficient low inpedance stereo headphones (8 to 600 ohms).

If the signal level at the headphone socket is too loud for comfort and the headphones do not have volume controls, then the level can be easily reduced by substituting a higher value for the 220 ohm resistors. Note that lower values should not be used.

It may be thought that the load presented by the headphones plus the 220 ohm resistor represents a very low value of load for the 741 operational amplifier. In fact this is not a problem since the output impedance of the circuit is only a few ohms, and the current it is required to deliver is considerably less than its maximum capability of 25mA.

The power supply has a number of interesting features. First, the synchronous motor of the transport mechanism is supplied with 110V from a tap on the primary winding of the transformer. Really this means that the primary winding acts like an auto-transformer which is a much more efficient method, in terms of size, than if a separate winding was used.

Incidentally, a number of readers have contacted us about running the transport motor directly from 240VAC, which at least one retailer has advocated. In this mode, the two motor windings are connected in series across the mains and capacitor is connected to the motor centre-tap.

We have warned against this in the past, in the November 1973 issue, but it seems we have to repeat it. The reasons are as follows:

When the motor is correctly connected to 110VAC, both windings have 110VAC applied to them with the capacitor merely providing the correct phase difference between windings to allow the motor to run at correct speed. In this case, the capacitor voltage is close to 175VAC.

In the "bodgie" series connection (and that is what it is), with 240VAC applied, one winding runs at 125VAC while the other and the capacitor run at 195VAC. Thus one winding is running at a substantially higher voltage than it was designed for. In addition, the motor draws more power than in the correct mode and is likely to radiate more hum and mains hash, which is induced into the record-play head. And the motor gets hotter.

But the most telling reason against the series connection is that the motor does not run at correct speed — it runs slowly and has poor load regulation. It easily falls out of "synch", which is manifested as quite serious speed fluctuations or "wow".

Balanced positive and negative supplies of 21V are derived from the 15V secondary winding of the transformer via a centre-tapped voltage-double rectifier (which can also be considered as two half-wave rectifiers in inverse-parallel). Initial filtering is provided by a 2200uF 25VW electrolytic capacitor for the positive rail and a 1000uF 25VW capacitor for the negative rail. The positive rail needs more filtering than the negative rail.

A 6V 40mA pilot light which illuminates the recording level meters is run from the minus 21 volt line via a 270 ohm 1 watt resistor.

The positive 21V supply rail is used to power the overload indicators, erase oscillator and signal switching relay.

All the operational amplifiers, six of them, are run from positive and negative 15V supply lines. This order of voltage was decided upon because performance of the

operational amplifiers is optimum with this figure.

Two 15V zener diodes fed by two 150 ohm 1W resistors are used to derive the 15V rails. The zener diodes are shunted by 470uF/16VW capacitors to provide further filtering. We have specified 1.5W zener diodes because they have a lower dynamic impedance than the smaller 400mW types, and thus provide better filtering of noise and hum.

All of the circuit components, with but a few exceptions, are mounted on a PC board measuring 178 x 178mm (7 x 7 inches).

While we have designed the copper pattern around 14-pin ICs for the 741s, the PC board is also compatible with the 8-lead "mindip" and 8-lead metal can package versions of the 741. This is by virtue of the fact that pins 1, 2, 7, 8, 12, 13 and 14 have no internal connection, while the remaining pins have the same orientation as in the smaller package.

For both 8-lead packages, pins 1 to 4 connect to pins 3 to 6 respectively of the socket pattern and similarly, pins 5 to 8 should connect to pins 9 to 12 of the socket pattern.

Speaking of sockets, we have not specified or used IC sockets in the prototype. While it is convenient to be able to easily change ICs, the price of six IC sockets adds a substantial amount to the total component price. And during our development we have not had a single failure of a 741. But if you want to use sockets, go ahead.

The board will accept all of the currently available transistor types such as Lockfit, TO-18, TO-92 and other encapsulations. Check the transistors you are supplied with against the appropriate base diagram on the circuit.

All of the electrolytic capacitors on the board are PC mounting types except for the 2200uF (or 2500uF) 25VW unit in the positive 21V supply. Pigtail types can be substituted though, if mounted "end on".

Note that the 1uF capacitors in the replay preamplifier inputs and in the metering amplifiers should be tantalum types. Voltage rating on these capacitors is not important.

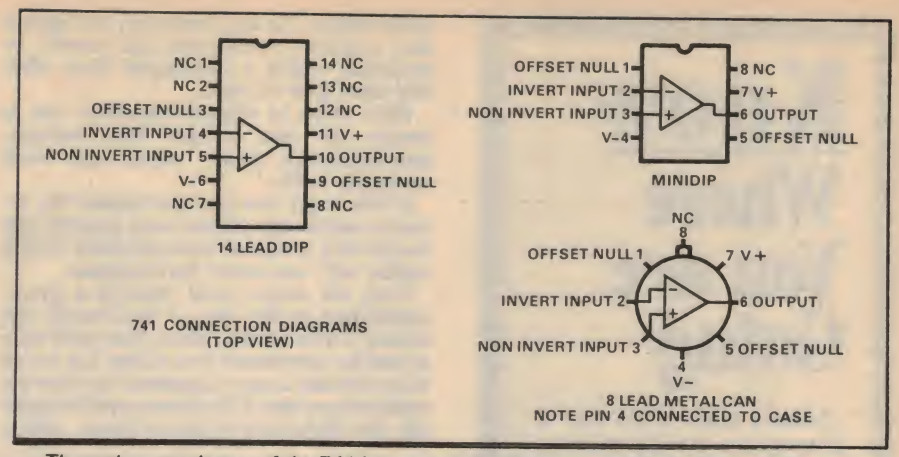
Perhaps two other electrolytics (47uF and 100uF) in the replay preamplifier should ideally be tantalum types also. This is to prevent the possibility of de-polarisation and eventual loss of capacitance (and increase in power factor) which can occur in electros. However, tantalums may be regarded as optional here because modern aluminium electros are very much improved in this regard compared to those of former years.

Other capacitors on the board are mostly PC mounting metallised polyester types. Other types may be used but size will generally be a problem. Two .047uF ceramic disc capacitors are mounted on the board near the relay, to bypass the long conductor lengths for the positive and minus 15 rails to the ICs.

The board has been designed specifically to suit ¼W resistors but ½W resistors may be used. Readers will notice that we have used both types. Three resistors should have 1W rating, the two of 150 ohms in the power supply and the 390 ohm feeding the pilot light. Whatever the rating, low noise types such as cracked carbon or metal film should be used.

Note that the 390 ohm 1 watt resistor will have to be installed vertically on the board because of limited space.

The two 1mH inductors used in the equalisation preamplifiers are a special type (VPC-1) with 27 ohms DC resistance supplied by Paris Radio and Electronics, 7 Burton Street, Darlinghurst, NSW 2010. We found it necessary to move one of the inductors (closest to the transofrmer) off the board because rectifier pulses from the transformer were being radiated into it.



These three packages of the 741 integrated circuit are compatible with the PC board.

A four-way tagstrip is used to mount the inductor adjacent to the microphone sockets. Neither side of the inductor is connected to chassis. A pair of insulated wires is run from stakes in the appropriate holes in the board to the tagstrip.

Note that ordinary 1mH RF chokes cannot be used here. The types specified are AF (audio frequency) chokes.

The relay is a Varley type VP4CAB/21 with four pairs of changeover contacts. It is mounted in a socket and held in place with a clip supplied with the socket.

We recommend that all interconnections to the board be made via PC stakes (or pins) such as McMurdo type 4737-04-08. You will need 39. With stages on the board, it can be dropped into place in the chassis and connections conveniently soldered to them.

There are several links on the PC board, four on top and five below. Of those on top, three are in the power supply section and one is adjacent to the relay. The links should be insulated with spaghetti (varnished cambric) sleeving. Insulated hook-up wire should be used for the long links below the board. These are shown dotted on the wiring diagram. Do not omit the short link underneath the board near the relay.

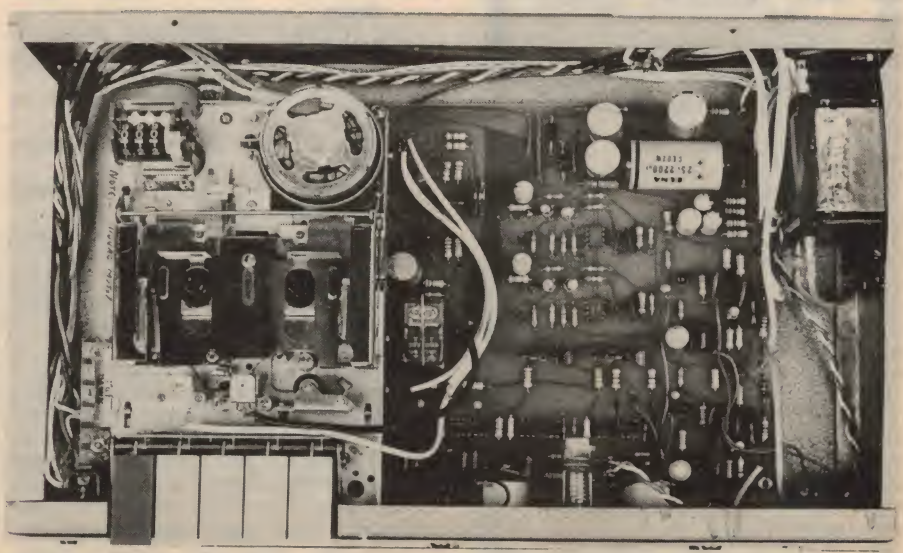
Apart from the above, there are two shielded interconnections going from one side of the board to the other. These carry the bias current for the record/play head. They can be run using two lengths of ordinary shielded cable or one length of figure-8 dual shielded cable. Either way, the shields are terminated only at the erase oscillator end of the board.

After the board has been assembled and soldered, there is quite a fair amount of assembly work to be done within the chassis. And the Vortex transport mechanism must be modified for installation in the chassis.

The chassis has the same external dimensions as the Playmaster 136 and 143 stereo amplifiers, ie 356 x 78 x 217mm (W x H x D) with cover to suit. The front panel of the chassis has two cut-outs, one to take the dual VU meter and one to clear the mechanism keys. On the left-hand side of the chassis the lip is wide, 30mm, to allow the power transformer to be mounted on it.

The cover of the chassis also has a number of cut-outs. One is to provide finger clearance on the keys and another is a large rectangular hole for the cassette well. There are also two holes, one elongated, for the revolution counter.

We modified a blank chassis kindly supplied by Messrs Wardrope and Carroll



An inside view of the Playmaster deck. A copper strap should be fitted to the transformer.

Fabrications Pty Ltd. However, we assume that complete metalwork kits should be available within a reasonable time after this issue goes on sale.

First steps in chassis assembly are to mount the four rubber feet, sockets, potentiometers, power switch and bezel mounting LEDs.

At this stage you can also install the inductor soldered to its four-way tagstrip and the six-way insulated terminal block for the mains cord and motor terminations.

Pass the mains cord through a grommeted hole in the rear of the chassis and secure it with a cord clamp. The earth wire should be terminated to a solder lug bolted to the chassis. Leave a generous loop for the earth wire so that if the mains cord is ripped out, the earth wire is last to break. Active and neutral wires are terminated at the insulated terminal block.

Install the transformer on the left-hand side of the chassis, as mentioned above. Recommended type is a low-profile Ferguson unit, PF 3723. We also recommend that it be fitted with a copper strap. Unless the kitset suppliers make arrangements to have this done, it is unlikely that the manufacturer will supply the transformer with the copper strap because of the extra cost involved.

This being the case, the constructor will have to do the job himself. You will need a strip of copper about 24 gauge, 180mm long and at least 60mm wide. A high power soldering iron is a necessity, either a mains-powered unit of at least 50 watts or a Scope iron. Thoroughly clean and "tin" each end

PARTS LIST

1 Vortex cassette mechanism fitted with heads and microswitch and supplied with five push buttons and 1uF 250VAC capacitor
1 chassis with cover, cassette lid parts and two brackets
1 front panel escutcheon
1 power transformer with 15V secondary and 110V primary tap at 90mA, Ferguson 3723 or similar
1 copper strap for above transformer
1 PC board, 74c9, measuring 178 x 178mm.
1 dual VU meter, 200uA sensitivity to suit 37 x 45mm panel cut-out (see text)
1 5-pin DIN socket
2 3.5mm jack sockets with shorting contacts
1 6.5mm stereo jack socket
1 spst miniature toggle switch
1 relay with 4 changeover contacts, Varley VP4 CAB-21 or equivalent plus socket and clip
2 1 millihenry AF chokes with 27 ohms resistance, Paris Radio VPC-1 or equivalent
1 6V 40mA pilot lamp, miniature Edison screw type
1 lampholder, miniature Edison screw type with right angle push-on clip

SEMICONDUCTORS
2 x EM401, BY126/100 silicon rectifier diodes
4 x 1N4148, 1N914A silicon signal diodes
2 x BZX70-C15 1.5W zener diodes
6 x BC109, BC149, BC184L low noise NPN silicon transistors
1 x BC107, BC147, BC182L silicon NPN transistor
1 x BC157, BC177, BC212L silicon PNP transistor
2 x BC108, BC148, BC183L silicon NPN transistors
2 McMurdo 3240-01-02 light-emitting diode bezels
6 x uA741 operational amplifiers, 14-lead DIP, 8-lead Minidip or 8-lead metal can

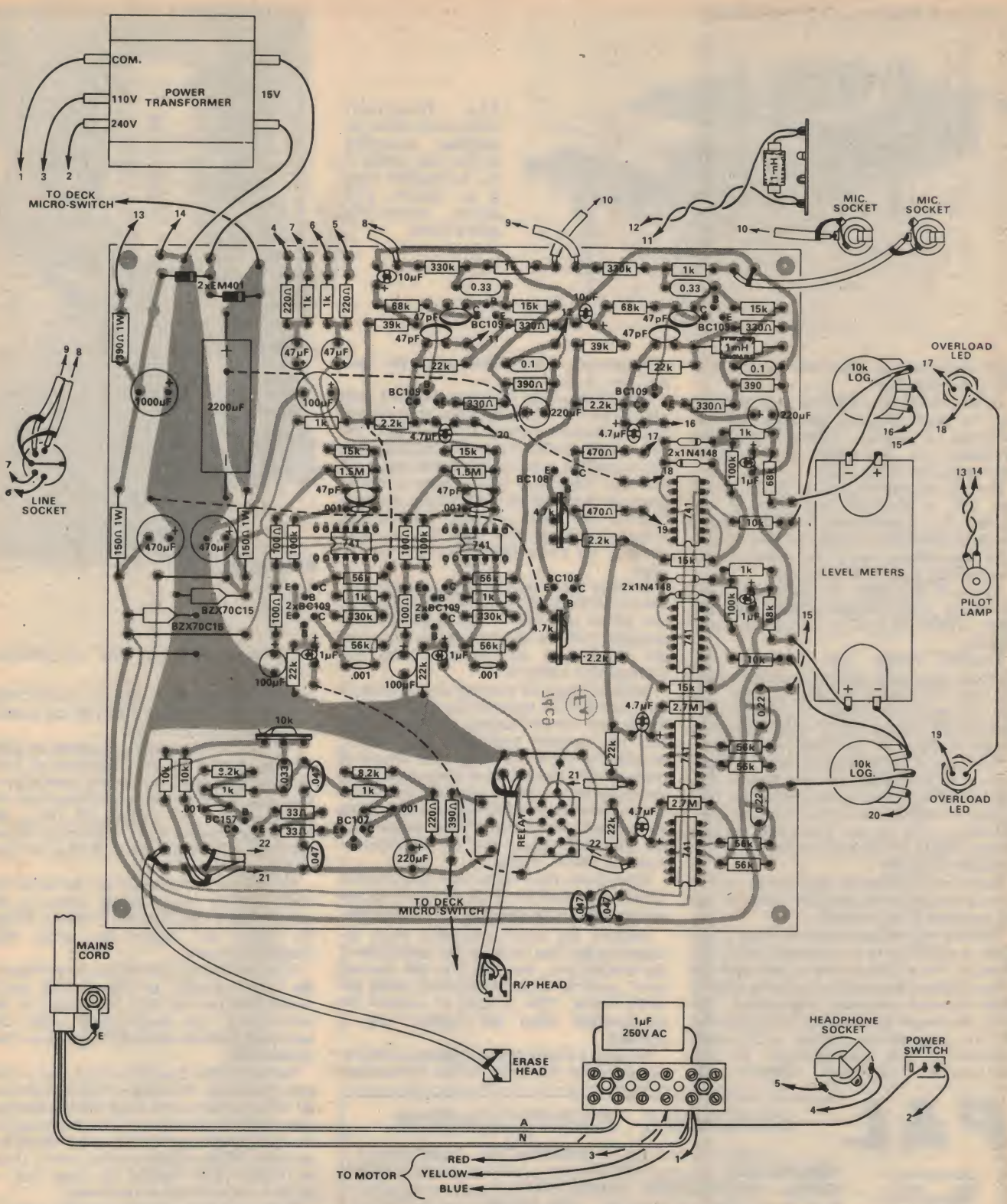
RESISTORS
(¼W or ½W, 5pc tolerance)
2 x 2.7M, 2 x 1.5M, 4 x 330k, 4 x 100k, 4 x 68k, 8 x 56k, 2 x 39k, 6 x 22k, 6 x 15k, 4 x 10k, 2 x 8.2k, 4 x 2.2k, 11 x 1k, 2 x 470 ohms, 3 x 390 ohms, 1 x 390 ohms 1W, 4 x 330 ohms, 3 x 220 ohms, 2 x 150 ohms 1W, 4 x 100 ohms, 2 x 33 ohms, 2 x 100k (log) potentiometers, 2 x 4.7k PC mounting preset potentiometers, 1 x 10k PC mounting preset potentiometer.

CAPACITORS
1 x 2200uF (or 2500uF) 25VW electrolytic
1 x 1000uF 25VW PC electrolytic
2 x 470uF 16VW PC electrolytic
1 x 220uF 25VW PC electrolytic
2 x 220uF 6VW PC electrolytic
1 x 100uF 16VW PC electrolytic
2 x 47uF 10VW PC electrolytic
2 x 10uF 16VW PC electrolytic
4 x 4.7uF 25VW PC electrolytic
4 x 1uF 16VW tantalum electrolytic
2 x 0.33uF 100VW metallised polyester or polycarbonate
2 x 0.22uF 100VW metallised polyester or polycarbonate
2 x 0.1uF 100VW metallised polyester or polycarbonate
4 x .047uF 40VW ceramic or metallised polyester
1 x .033uF 40VW ceramic or metallised polyester
6 x .001uF 100VW metallised polyester or polystyrene
6 x 47pF 125VW ceramic or polystyrene

HARDWARE
39 PC stakes, McMurdo 4737-04-08 or equivalent
1 6-way insulated terminal strip
1 4-way miniature tagstrip
6 1 inch tapped brass spacers (or equivalent to make 3 2-inch spacers; see text)
2 knobs to suit front panel
1 mains cord clamp
1 solder lug
assorted ⅛-inch Whitworth countersunk and roundheaded screws, nuts, lockwashers
6 self-tapping screws and nickel-plated washers to match.

MISCELLANEOUS
Various colours of hook-up wire, shielded cable, tinned copper wire, spaghetti sleeving, three-core mains flex, three-pin plug, electrical insulation tape, contact adhesive, epoxy adhesive, vinyl covering material, perspex, solder, patience.

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, provided they are physically compatible. Components with lower ratings may also be used providing ratings are not exceeded.



We have shown both DIP packages on the PC board. Follow this diagram in conjunction with the circuit and photographs..

of the copper strip with solder before wrapping it tightly around the transformer and soldering.

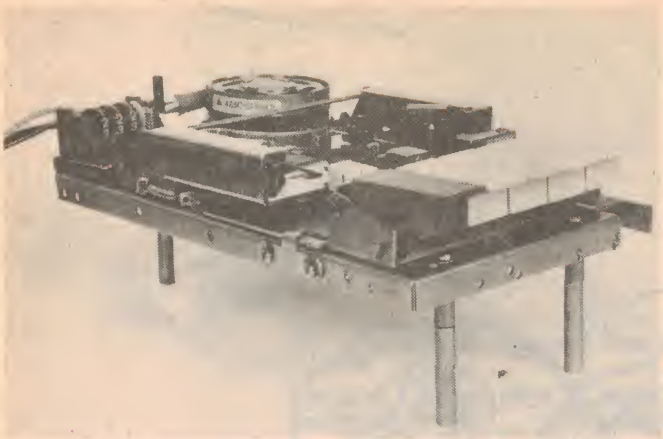
A set of leads with push-on connectors is supplied with each transformer. The 15V secondary leads are passed between one of the channels on the back of the transformer housing and the copper strap.

The three primary leads need to be extended by about 300mm with hook-up wire of the same colours. Solder the wires and then sleeve the joints with spaghetti or tape. These wires are also terminated at the insulated terminal block. Note that the hook-up wire used here should have insulation rated for 240VAC operation.

The dual VU meter was supplied by Electronic Agencies, of 115-117 Parramatta Road, Concord South, NSW 2137. Electronic Agencies advise us that they will make supplies of these meters available to other kitset suppliers.

The meter is held in place by a bracket made from a strip of metal 11mm wide. The foot of the bracket is secured by one screw and nut to the floor of the chassis, underneath the PC board. Make sure that this screw does not foul the underside of the board. The bracket is "sprung" to hold the meter securely in place.

Illumination of the meter is provided by the 6V 40mA lamp which is mounted in a miniature Edison screw socket. This has a



The transport mechanism must be modified according to the text before it can be installed. Here it is shown with three mounting pillars fitted.

right-angle push-on clip which secures it to the meter bracket.

Other meters of a different configuration may be used, provided the constructor is prepared to devise different mounting arrangements. Sensitivity of the meter movements is 200uA FSD.

Having proceeded this far, the PC board can now be dropped into place in the chassis. It is spaced away from the chassis by about 8mm with screws and nuts. All the interconnections, except for those to the mechanism, may now be made.

You will find that the McMurdo LED indicators have one lead thicker than the other. The thick lead is the negative connection.

Shielded cables are used for the microphone inputs and for the inputs from the 5-pin DIN socket on the rear panel. For the mic inputs, the shields of both cables are terminated at the sockets, which should be wired as shown in the circuit diagram.

Only one of the shields of the mic input cables is terminated on the board. The shields for the input cables from the DIN socket are terminated to pin 2 of the socket. Shielded cable is not necessary for the output signal to the DIN socket or to the headphone socket.

Some work must be performed on the Vortex transport mechanism before it can be installed in the chassis:

Three 2-inch pillars must be fitted to the deck to enable it to be mounted inside the chassis. Two 1-inch or two ¾-inch and one ½-inch tapped brass pillars may be used to make up each composite brass pillar. The short sections are joined together by screws of the appropriate thread with heads removed. The photograph of the mechanism assembly shows the arrangement of the pillars, one at the back and two at the front.

The pillars at the front are mounted with centres on a line 8mm from the front edge of the mechanism chassis. On the right, the pillar centre is 20mm from the RH edge and the two pillars have centres 59mm apart. At the rear, the single pillar centre is 45mm from the RH edge and 8mm from the rear edge of the mech chassis. Incidentally, when we mention the edge of the mech chassis, we are referring to the outside edge.

Remove the microswitch from the underside of the mechanism and attach it with one screw and nut to the small bracket supplied with the chassis. Make sure that the screw and nut do not touch the microswitch contacts.

Solder a length of hook-up wire to each of the two contacts nearest the bracket foot. These are normally-open contacts which can be verified with your multimeter switched to the ohms range. One length of hook-up wire about 140mm long connects to the stake on the board adjacent to the 390 ohm resistor associated with the relay. The other length, about 400mm long, connects to the plus 21V supply via the appropriate stake on the PC board.

Now attach the bracket and microswitch assembly to the floor of the chassis with one screw and nut, as shown in the photograph.

Remove the small extension piece attached to the Play lever, on the underside of the mechanism. Now fit it to the Record lever, with the same orientation, using the same screw. This is used to actuate the microswitch when the Record key is pressed.

We used a 2-part Araldite epoxy adhesive to secure the five keys to the mechanism

Microswitch assembly and 1uF 240VAC capacitor.

levers. Follow the adhesive instructions carefully when mixing. The red key is used for the Recording button.

Apply a modest amount of adhesive to the central channel on the underside of each key and then position the key carefully on the lever. When all keys are in place and are in no danger of falling off, turn the mechanism upside down. Otherwise excess adhesive will drip down and lock the key latching bar.

Extend the three leads from the motor by about 160mm with hook-up wires of the same colours (red, blue and yellow). Solder the wires and sleeve the joints with spaghetti or tape.

Be careful when drilling the three holes in the mech chassis, to ensure that metal swarf does not fall into the motor or the mechanism. Use lockwashers under the screw heads when securing the pillars to the mechanism.

Normally, the Stop-Eject key has a two-step operation. Pressing it lightly releases all the other keys and stops the mechanism (the motor and capstan run continuously though); pressing the key harder ejects the cassette. If the cassette ejects every time, no matter how lightly the Stop key is pushed, adjustment is necessary.

There are two adjustments that can be made here. The catch on the underside of the cassette "carrier" is bent to latch more positively. And the angle of the spring-loaded tab operated by the Stop lever, underneath the mech, can be altered slightly.

Having completed the mechanism assembly, you can now direct your attention back to the chassis.

Check that all connections are correct and connect the power. Check all the DC voltages on the circuit. Apart from the 21V supplies, all voltages should be within 1V of

the values shown on the circuit diagram. The 21V supplies will vary according to the mains voltage.

Verify that the relay closes when the microswitch is actuated by hand. This being okay, the mechanism can be installed and the heads connected. Check that the recording lever operates the micro-switch and adjust if necessary.

Now connect the extended motor leads to the terminal block and also connect the 1uF 250VAC capacitor. The pigtails of the capacitor should be sleeved to avoid the possibility of shorts or shock while dabbling inside the chassis. All the mains wiring can now be completed. Cover the rear of the power switch with insulation tape.

With the Record key depressed, the erase voltage can be measured. You will need an oscilloscope or a multimeter, FET voltmeter or VTVM with a frequency response to at least 100kHz. The voltage across the erase head should be 17V RMS (plus or minus 1V RMS). Observed on an oscilloscope the sinewave should be distortion-free and have a value of 48V P-P (plus or minus 2.8V).

At the same time, you can set the bias voltage across the record head to 8V RMS (22V P-P) using the 10k preset potentiometer.

At this stage you are ready to listen to the deck, provided you have a recorded cassette. Connect a set of headphones or connect the deck to a stereo amplifier and loudspeakers. Having satisfied yourself that residual noise and hum are okay, the overload indicators can be set.

Connect an input signal of between 300Hz to 1kHz at several hundred millivolts or so, and adjust the recording level control until the appropriate meter pointer indicates 0-VU. Then adjust the appropriate 4.7k resistor until the corresponding LED indicator barely glimmers (in subdued lighting conditions). Repeat the procedure for the other channel.

If you propose to perform a record-replay frequency response test of the Playmaster deck, it must be made at a level of not more than minus 20VU, otherwise it is not likely to do as well as the prototype.

Incidentally, the linearity of the VU meter scales is not good. It is our opinion that the minus 10VU calibration should be further up the scale towards OVU. In fact, it should correspond to the unmarked calibration between minus 6 and minus 10VU. Some constructors may care to recalibrate their meter scales along these lines.

If you suspect that frequency response on pre-recorded cassettes is not as good as it should be, you may need to adjust the record head azimuth. To do this you will need a frequency response test tape made on a machine with correct azimuth setting.

With a playback signal of 6kHz (or thereabouts) turn the adjusting screw (ie, the spring-loaded head-securing screw) for the highest peak readings on the VTVM for both left and right channels. If the highest peaks do not coincide, adjust the screw for the mechanical mid-position between the two peaks. Note that several peaks may occur — take the highest. The difference between the highest peaks for each channel and the final azimuth setting should be within 1dB.

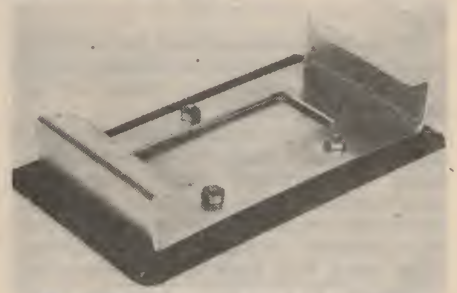
When all circuit adjustments are correct the front escutcheon can be installed. This will necessitate temporarily disconnecting the LED indicators.

Some words about the operation of the cassette deck. At switch-on, it is normal for the overload indicators to flash and for the meter pointers to swing well up scale. Similarly, at switch-off, the overload indicators flash, the meter pointers swing up the scale towards 0VU. In fact, it should

There is one point to watch with the deck if you have it connected to a stereo amplifier. Normally, it is fairly quiet in operation. But if you are in the Replay mode with the amplifier volume control well advanced and then press the Record key (assuming the cassette lets you do this), a loud bang will come from the loudspeakers. While this may not do any harm, it can be rather startling.

For lowest hum performance from the Playmaster cassette deck, the steel cover must be fitted. This also reduces the possibility of radar interference (which can occur near airports and naval installations) to a minimum. Radar interference is characterised by periodic buzzing sounds from the loudspeakers — rather like an angry bee buzzing your ears. And just as annoying, when you're trying to eliminate it!

We covered the steel topcover with a vinyl material, using a contact adhesive. Some care is necessary to avoid bubbles in the vinyl. Be sure to spread the adhesive out smoothly. We found it best to work in two stages: stick the vinyl to the top and sides of the cover first; then apply adhesive to the inside of the cover, as per the instructions, and wrap the vinyl round the edges with plenty of overlap.



The slide-on cassette cover assembly.

Final job of assembly is the cassette carrier cover. This comprises two aluminium sections with a piece of perspex about 2mm thick in between. We have specified aluminium in this assembly because a steel unit would be too heavy to ensure a good eject action.

First insert three countersunk screws into the top section and secure each one with a nut and lockwasher. Make sure the screw heads are on the correct side of the plate. Refer to the photograph. Now cover the plate with vinyl to match the chassis top cover. This done, the two sections can be secured together with nuts, with a suitably sized piece of perspex sandwiched in between.

The chassis top cover should now be installed. Make sure that the drums of the revolution counter have adequate clearance to spin freely.

Use nickel plated washers under the six self-tapping screws used to retain the cover. These prevent the vinyl covering being damaged by the screws.

The cassette carrier cover is a push-fit onto the carrier. Push it all the way down and check that the whole assembly will close and eject correctly, with a cassette.

And that is the finish. Happy listening!

A phase-shift vibrato unit for electronic organs

With modern techniques and components, it is relatively easy to add an effective phase-vibrato system to an electronic organ or other such instrument — either as an overall facility or limited to selected channels. This article explains the background to the vibrato facility and details a practical, modern unit.

by NEVILLE WILLIAMS

To add variety and interest to sound, music makers commonly adopt the trick of modulating — or varying in periodic fashion — either the frequency or loudness of the sound, generally at the rate of a few cycles per second (or Hertz).

Singers achieve a modulating or pulsating effect by suitable control over breath, vocal chords and mouth configuration. Tone, amplitude and frequency are all likely to be modulated and, depending on the vocal expertise of the singer, the result can be variously pleasing or displeasing.

Violinists commonly modulate the frequency of notes by rocking the fingers of the left hand, which are being used to "stop" the strings. "Pop" guitarists achieve a similar result by means of a lever, which allows the tension of the strings to be varied in a periodic manner.

The technique of periodically varying the frequency of a musical note is commonly described as "vibrato."

Vibrato rates usually lie within the range 5 to 8 Hertz with 7Hz probably the most commonly used figure. Rates outside this range are sometimes used but only for rather special effects.

In acoustic organs, it is not easy to modulate the frequency produced by the pipes and an alternative approach has long been used of varying the pressure of air to the pipes in a periodic fashion, usually by means of small, mechanically driven supplementary bellows. Varying the air pressure has a minor effect on frequency but its main effect is to vary the loudness of the sound produced.

The technique of modulating the loudness of notes is commonly referred to as "tremulant." As with vibrato rate, tremulant rate usually falls in the range 5-8Hz.

Vibrato or tremulant effects are exploited heavily in modern electronic organs, partly from necessity, partly by reason of opportunity. Let's explain this:

When a complex chord is played on a pipe organ, the sound as heard is the resultant of many independent pipes, speaking simultaneously. For practical reasons, organ pipes are never perfectly in tune and the constantly changing phase relationships, along with their spatial separation emphasises the complexity of the chord and adds to its aural interest.

Electronic organs, for the most part, are designed within limits of cost and complexity which dictate the use of a much smaller number of sound source generators. In many cases the generators are highly interdependent, which makes for ease and accuracy of tuning, but the phase relationships are locked rather than random and variable. And, of course, the sounds are usually propagated through common loudspeaker channels.

Compared with a pipe instrument, the chord structures from an electronic organ tend to lack complexity and aural interest; or, to borrow a phase, the unembellished sound tends to be "bland."

This being so, the designers of electronic organs have been forced to adopt measures to render the sound less bland. They — and the players — have come to rely on vibrato and / or tremulant effects to a much greater extent then is traditional or necessary in pipe instruments.

In general, two vibrato rates are utilised. The one already mentioned, about 7Hz, is used mainly for "theatre" or popular music. The second, about 1Hz, is used for "church" or formal or classical music, to simulate the effect of random beats or a very slight deliberate shift in the tuning of certain ranks.

So much for necessity.

As far as opportunity is concerned, designers of electronic organs can draw upon a wide range of techniques, either to simulate traditional organ effects or to achieve others which have no obvious counterpart in acoustic instruments.

A tremulant effect can be achieved by causing the gain of a stage in the amplifier to vary at the desired tremulant rate. Alternatively, it is possible to introduce into the signal path a resistive element whose value varies in a cyclic manner. In current practice, this commonly takes the form of an LDR (Light-Dependent Resistor) illuminated by a small pulsating lamp.

More significant, however, is the fact that an electronic organ designer can outdo his acoustic counterpart by providing full vibrato. This can be achieved by suitably varying the operating conditions of valve or transistor oscillators, or by varying the reactive quantities in the frequency determining circuits.

Should it be considered desirable, there is no special problem about providing part tremulant, part vibrato, making either peculiar to individual organ voices, varying modulation depth and speed, or even providing different rates simultaneously for special effects.

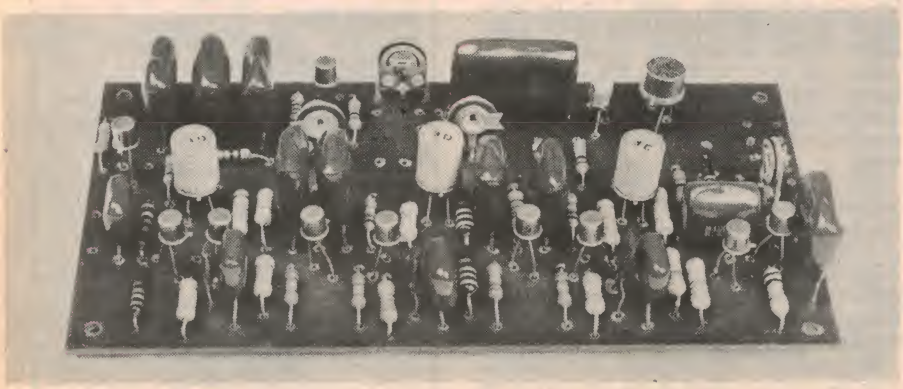
It has been stated fairly frequently that there is not a great deal of difference aurally between tremulant and vibrato and this is, in fact, a conclusion one might easily reach, based on observation of single tones or even simple chords. In both cases, the main aural impression is a rapid fluctuation in the loudness of the sound.

With tremulant this is exactly what one would expect to hear, because the signal is, in fact, being modulated, in terms of loudness or amplitude.

With vibrato, or frequency modulation, the effect has to be explained on a completely different basis.

Imagine that a pure, unvarying tone is being propagated into a listening area. What the listener hears is a mixture of

The material has been adapted from an article which appeared originally in our March 1969 issue. The practical unit has been up-dated to use modern components and a printed wiring board.



Our prototype unit. The signal path is in the foreground, from left to right, with the low frequency oscillator behind it. The voltage regulator and 1uF filter were not in position when the picture was taken.

derived from a common oscillator / divider system.

Undoubtedly, direct modulation of the oscillators is the easiest way to produce a dramatic degree of vibrato and, for this reason, it is a common choice for simpler instruments. But, as indicated, it has its drawbacks, too.

Phase modulation can be achieved in a number of ways, some of them mechanical, as by rotating capacitors, rotating transformer elements or rotating loudspeakers. Electrical systems include sequential sampling of the 180-degree displaced signals across a push-pull signal source and / or deriving signal from an R / C phase-shifting network of which one or more elements are varying in a cyclic fashion.

In applying the electrical systems a major problem is to achieve phase modulation without simultaneously modulating the amplitude or generating a spurious 7Hz signal. It is all too easy to end up with a system which is more akin to tremulant than vibrato, or which "pumps" the loudspeaker cones at a very low frequency.

A basic electrical phase modulating circuit is shown, in simplified form, in Fig. 1. In essence, it consists of a single stage phase splitter providing two signal sources, one at the collector and the other at the emmitter, out of phase by 180 degrees. The modulated output is taken from the junction of a capacitor and resistor which are connected in series from collector to emitter.

To reach the output terminal, the signal being handled has two possible paths: one from collector via capacitor C, and the other from emitter via the resistance element R. Fairly obviously the collector signal will predominate if the reactance of C is small compared with the resistance of R. If the reverse condition applies, the emitter signal will predominate.

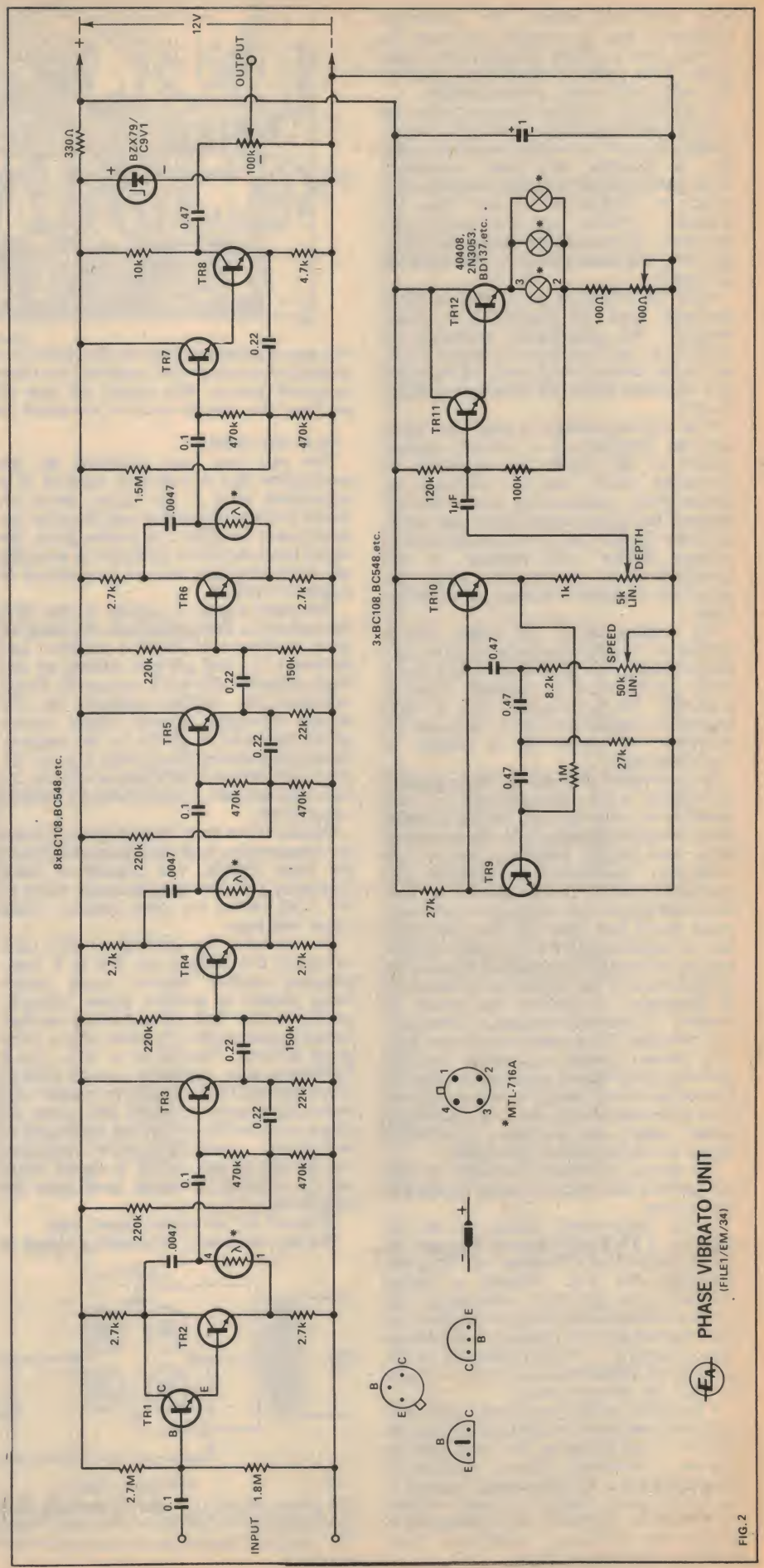
For the present purpose, the appropriate objective is to arrange a quiescent value for R which is practical in terms of the component itself, and which is neither so high as to be inconvenient nor so low as to load unduly the phase splitting stage. C can then be selected so that its reactance is equal to the resistance figure in the centre of the musical range over which the vibrato is to operate.

At this selected frequency, under quiescent conditions, the output signal will be 90 degrees displaced from the input signal. At lower frequencies the phase will rotate progressively towards that at the emitter while, at higher frequencies it will approach that of the collector. In itself, this will have no audible significance.

However, a cyclic variation in the value of R will produce a cyclic variation in the phase of the signals over a wide range of frequencies centred on the quiescent condition. Thus a reduction in the value of R will cause the phase of the output signals to approach that of the emitter, while an increase will have the reverse effect.

Mathematically, the output resultant may be related to a vector swinging back and forth within the limits of 0 and 180 degrees of phase shift.

Ideally, the value of R should vary bet-



The basic phase vibrato circuit, as used in our prototype. External switching must be arranged to cut the unit in or out of circuit or render the vibrato inoperative. Speed and depth controls can be brought out to the console if desired.

ween zero and infinity for maximum modulation but, in practice, we must be content with a swing between two finite limits. This practical limitation modifies the modulator's basic characteristics.

A resistance variation between zero and infinity would provide a full 180 degree modulation over the whole frequency range but, in practice, the finite resistance variation compared with the reactance of C results in modulation of less than 180 degrees centred on one particular frequency. At frequencies above and below this point the phase deviation will taper off gradually.

While the reduction of maximum phase deviation from 180 degrees is a disadvantage, the progressive reduction of modulation for frequencies towards either end of the musical range may be regarded as a desirable effect, for reasons explained earlier.

It is also interesting to note that while constant amplitude is a natural characteristic of the circuit, an amplitude or tremulant effect can be obtained by deliberately introducing some loading between the signal output point and earth, as shown dotted. This extra loading forms a voltage divider with resistor R and variations in the latter then affect the amplitude of signal reaching the following stage.

For application as an organ vibrato system the value of R must be made to vary electronically at a rate of between 5 and 8 Hertz (or at 1Hz if a "celeste" effect is required). To accomplish this, a light dependent resistor or LDR is used and its resistance is varied by a source of modulated light.

In the original 1969 article, these general principles were incorporated in two practical circuits, the first having a single phase modulating stage, with the necessary input and output buffering and a low frequency oscillator to provide the modulating signal. It was pointed out that the single stage could produce a maximum swing much less than 180 deg. adequate only for applications where a very modest amount of vibrato was required. It was also pointed out that the subjective effect could be increased by loading the circuit to produce "a judicious amount of tremolo".

In practice the simpler circuit has had very limited appeal, apparently because most organists want a generous vibrato for at least part of the time. For this reason, we have redeveloped only the more elaborate circuit, which can provide a meaningful choice of vibrato speed and depth.

The circuit as shown is similar to that published in 1969, but with some significant differences.

It was resurrected mainly at the instigation of Mr Brian Cleaves, manager of the Components Division of Plessey Australia Pty Ltd. Needing a phase modulator for his own instrument, Mr Cleaves recalled the circuit in question; he also realised that his company's miniature "opto couplers" — units containing an incandescent filament and an LDR — might be ideal for such a device.

A prototype phase modulator, built on a printed wiring board, worked so well that he drew it to our attention. We built another one on a re-worked pattern, installed it temporarily in a different organ and set it up for the best subjective vibrato effect. This done, we checked it on instruments to verify the operating conditions. Fortunately, they made sense!

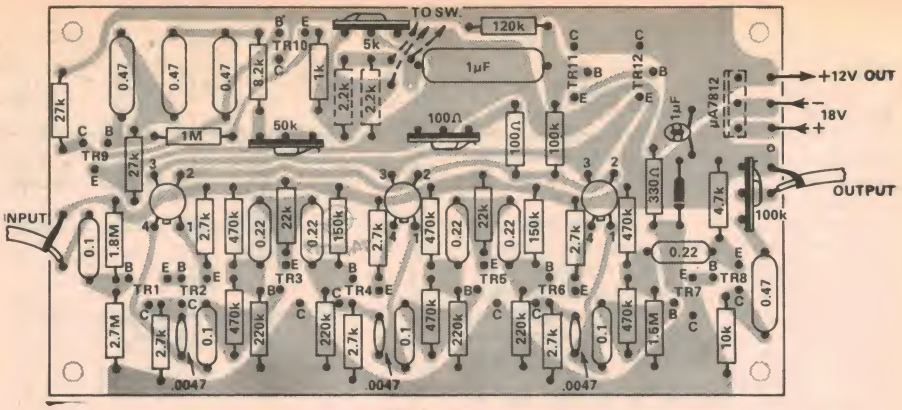


FIG. 4

The layout of components on the printed wiring pattern 74/em9. A 12V regulator is shown dotted in the appropriate position if it is desired to power the unit from a higher voltage, non-regulated source. Also dotted are two typical resistors and two switched links in the positions they would occupy if the depth potentiometer was to be replaced by switching.

So to the circuit:

The unit has been designed on the assumption that it would be inserted at a convenient point in the signal chain adjacent to the preamplifier and ahead of the main power amplifier. At such a point, the signal level should be sufficient to override any noise problems but not so great as to produce overload.

The input signal is applied to the first transistor in a Darlington pair, ensuring an input resistance of about 1 megohm and sufficient to avoid adverse loading on any likely circuit to which it is connected. Equal collector and emitter resistors for the second transistor provide signal source points displaced in phase by 180 degrees. Connected between these points is a .00[illegible] uF capacitor and the LDR element of an MTL-716A opto coupler, as distributed by Plessey components.

Signals taken from the junction of these two components, and their phase relative to the input signals, will depend on their frequency and the instantaneous value of the LDR within the opto coupler. More about this later.

To minimise the loading on the LDR circuitry, the signals are fed to a bootstrapped emitter follower stage before being passed to another phase network, similar to the first. Then follows another bootstrapped emitter follower and a third phase network. This feeds, in turn, into a Darlington pair, providing enough gain to offset the small but cumulative losses in the preceding stages. A preset pot across its output permits the gain of the whole unit to be adjusted — normally to unity — so that it can be cut in and out of a signal chain without altering the sound level from the instrument.

So much for the actual signal path.

The low frequency modulating signal is generated by a phase-shift type oscillator involving T9 and T10. The circuit includes provision to vary the frequency and the amount of modulating signal fed to the transistor pair T11 / T12, which impresses the low frequency signal across the three filaments in the opto couplers. (Note that the 1uF coupling capacitor should be a polyester type).

The intention, of course, is to make the filaments pulsate smoothly at the selected modulating frequency, thereby producing a sympathetic variation of the associated light dependent resistors.

And here we move into the rather nebulous area which accounted for the unusual procedure mentioned earlier: make it work first, check it on instruments later!

Information on the MTL-716A opto couplers is sparse, being substantially confined to normal filament rating (5V, 30mA) and a minimum, a maximum and a median value for the LDR.

On a purely trial-and-error basis on a couple of organs, we set the bias on T12 to produce the maximum vibrato effect in the melody region of the keyboard around A-440Hz.

A subsequent check on the setting on the test bench, without vibrato drive, indicated that the lamp was operating very close to 1V, and that the LDR value was about 68K. This approximates the reactance of .0047 at 500Hz, indicating that the 90-degree quiescent phase shift condition was, indeed, very close to target. With drive applied, the phase would swing either side of 90 degrees.

The waveform from the oscillator, as viewed on the oscilloscope, was smooth but certainly not symmetrical and this might have led to some apprehension. However, it is not used directly. It drives an incandescent filament which tends to act as a

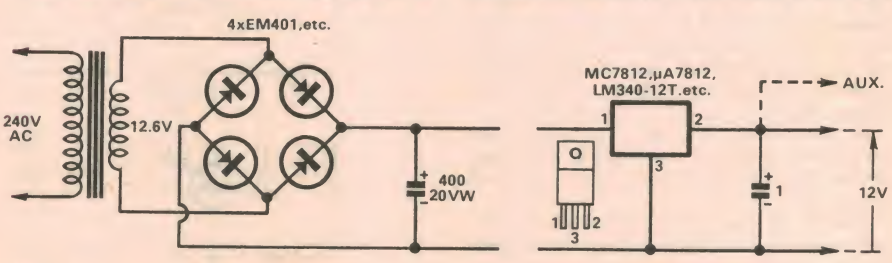


FIG. 3

The phase vibrato unit can be operated from a simple power supply as shown, provided a 12V regulator is installed in the position provided on the board. In this case the regulated 12V rail could also be used to operate miniature reed relays actuated by push-buttons on the console.

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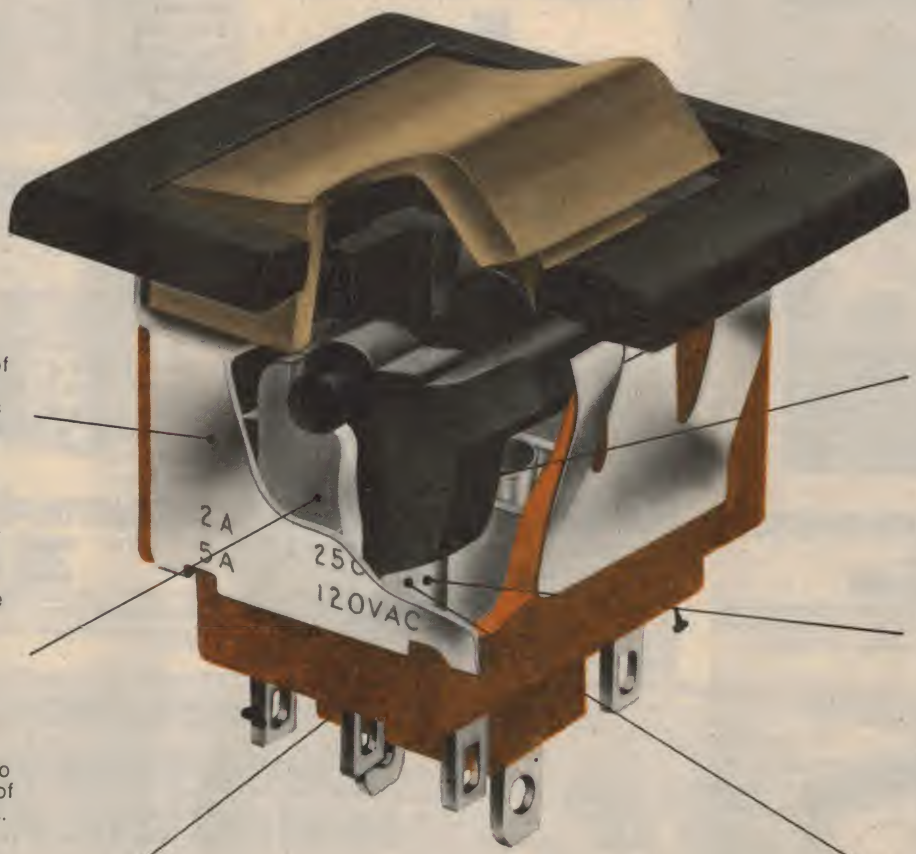

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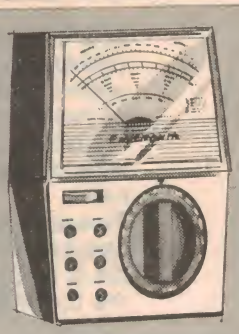

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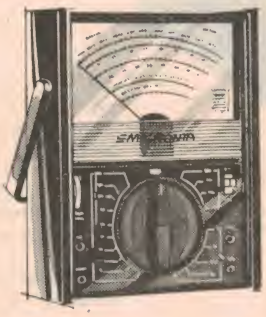

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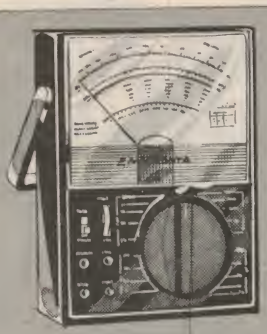

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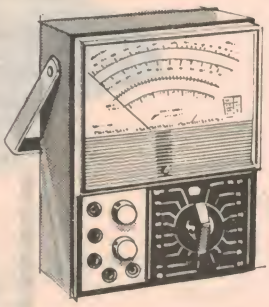

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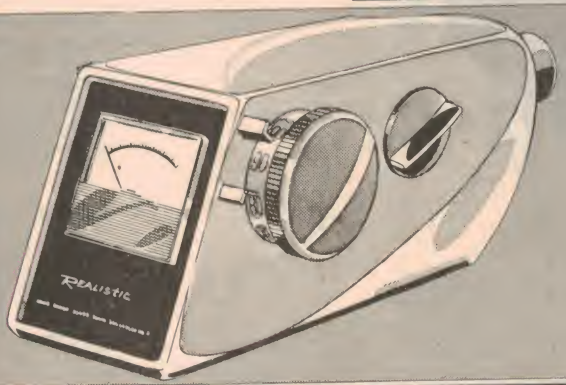

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low-pass filter by reason of its thermal inertia; this, in turn, affects an LDR with its own non-linear characteristic and both are subject to considerable tolerances anyway!

The important point was that the vibrato effect, as heard, was entirely acceptable, despite the surprisingly low voltage applied to the lamps. This voltage is dependent, by the way, on the resistance in the emitter return of T12, provided by a 100 ohm fixed resistor and a tab pot which can, in practice have a value of anywhere between 50 and 250 ohms. Reducing the value increases the current through the lamps, reducing the resistance of the LDR elements and shifting the vibrato spectrum bodily upwards. To a limited extent, the pot can be regarded as having this function.

In practice, the resistance in both developmental units ended up at 130 ohms and we suspect that this might prove to be about the optimum figure for most such units.

Having the lamps operating at a low voltage has two advantages — economy of current drain and an operating life that should be very long indeed. Total current drain of our prototype unit, in the operating condition as set up was 55mA into the 12V line. Allowing for the current to the 9V line, this would suggest about 14 or 15mA for each of the filaments — about half their normal operating current.

If a 12V source is available, reasonably filtered and regulated, it can be fed directly between the earth pattern on the wiring board and the 12V pattern, which runs along the edge adjacent to the low frequency oscillator components. This done, the series resistor and zener will look after the 9V rail automatically.

However, the board does have provision to include a 3-terminal voltage regulator such as MC7812, UA7812 or LM340-12T. Either the 1-amp or 0.5A versions would be satisfactory, which certainly helps because they have all been in rather patchy supply. To provide a properly regulated 12V out, the input voltage must lie between a maximum of 19V and a mimimum of 14.5V (including ripple). Figure 3 shows a typical simple supply which could be used. If fed with 18V, the 12V line could obviously be used for other items and, for this reason, an optional 12V take-off point had been provided on the board.

By way of example, the 12V rail can be used to power one or more miniature 12V reed relays wired to change over signal circuits, control vibrato off-on, depth, speed, &c. The likely requirements are mentioned in the panel alongside.

A couple of other points about the board layout warrant special comment.

The 50K vibrato speed control is shown as a tab pot which can be preset at the desired speed, thereafter remaining untouched. In fact, the author synchronised it with the Leslie loudspeaker at its higher speed, partly as an alternative form of vibrato and partly to anticipate beat effects.

If it is desired to control vibrato speed from the console, the pot mounting holes can become the anchor points for wires running away to a separate pot or to a switch and resistors giving a fast / slow option.

Similarly, another tab pot was used on the prototype board and preset at somewhat less than maximum for a suitable vibrato depth. Again, the same anchor points could be used for a pot brought out to the face of the console. On the pattern itself we show yet another option in which the pot element has been replaced by a couple of fixed resistors. By using a console switch to close neither or either link, the player can have the option or nil / half / full vibrato. Fairly obviously, the proportions of the three resistors involved can be varied to suit individual needs.

For the rest, the board is relatively straightforward and should involve no more than identifying the various components and soldering them appropriately in place. You will need to exercise some care with the transistors, however. While the board pattern has been drawn for transistors having their leads in triangular formation, the supply position may dictate the use of the TO-92, configuration with in-line leads; connections vary from brand to brand and need to be checked.

INSTALLING THE VIBRATO UNIT IN AN ORGAN

Whereabouts in the circuitry to install a vibrato unit will vary with the instrument and the requirement, and needs to be carefully planned beforehand.

In a simple, single-channel instrument, without adequate vibrato, a phase type unit can logically be introduced into the signal line to the main amplifier, preferably in a way which will not include the bass pedals.

In a two manual instrument, it may be possible to provide switching so that the signal from either keyboard can be fed through the vibrato unit or direct to amplifier, giving a choice of vibrato on either or both manuals.

With some organs it may be difficult to do this if inter-manual balance controls operate where the signal lines merge. It may be necessary to use a second vibrato unit or to make other arrangements for controlling inter-manual balance.

Where the organ has separate channels for each manual, or group of voices, and it is desired to preserve the separation, two or more vibrato units will certainly be necessary. They can, however, share drive from the one low frequency oscillator, as does the Schober instrument. (See page 49, July 1974 issue).

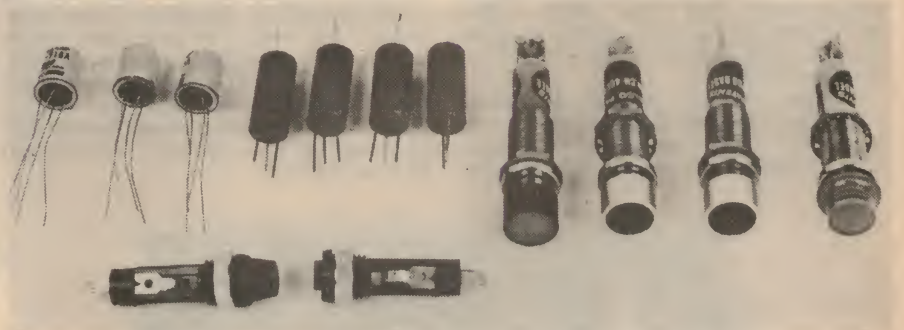
One very typical situation involves spinet organs which have fully controllable vibrato on the master oscillators, being therefore common to both manuals. While adequate for full "theatre style" playing, it is not possible to play a straight solo voice against a vibrato accompaniment. This becomes possible however, if a single phase vibrato unit is made available to the lower manual only. It can be cut into circuit ahead of any inter-manual balance control, being preset to an appropriate speed and depth.

The method of control must also be considered. In some cases it will be simplest to wire the vibrato unit permanently in the appropriate signal path, simply cutting out the low frequency oscillator for "straight" sound. The oscillator can be cut out either by turning down the depth control (if on the console) or opening the signal drive to TR11, or earthing the collector of TR9.

In other cases, it may be necessary to have the switching in the actual signal path. To avoid the necessity for long, shielded signal leads to console switches, it is worthwhile considering the use of miniature reed relays such as the OKI URD-113 units illustrated. Drawing a nominal 17mA, they can be operated from the 12V rail in the vibrato unit. They have only open/close contacts but two of them, suitably activated can perform a signal changeover function.

To control reed relays, an attractive range of Sloan Color-Lite switches is now available offering a push-on push-off changeover function and a button that lights up in one mode. Different bezel colors are available, along with a spring-loaded push-on switch, and simple push-buttons and bezels.

Physically, the attraction of these items is in their finish and neat single-hole mounting. The hazard of unsightly additions to a console is largely obviated. (The components illustrated are distributed in Australia by the Professional Components Dept, Plessey Australia Pty Ltd, P.O. Box 2, Villawood, NSW 2163.)



These items, available from the Plessey Professional Components Dept, should have a special appeal to enthusiasts who may wish to extend an existing instrument. At top left are three Moririca MTL-716A opto couplers incorporating an incandescent lamp and an LDR, and providing the basis for the phase vibrato unit, described here. At top centre are four OKI miniature reed relays type URD-113 which combine an off-on switch function with an energising coil to operate at up to 12V and between 10 and 17.5mA. At the right are the illuminated Sloan Color-Lite push-button switches, available either in a spring-loaded or push-on push-off action. In the foreground is a miniature indicator bezel (left) and a spring-return push button (right). The long threaded shanks would be an advantage where switches must be mounted through wood.

Our EDUC-8 computer: starting construction

Having introduced our unique digital computer project and described how it works, the author now starts to describe its construction. Both circuit and wiring details are given for the power supply, front panel board and mother board sections, which together form the foundation of the machine.

by JAMIESON ROWE

EDUC-8 is built into a case of about the same size and shape as a medium-powered stereo amplifier. The case measures 29.3cm wide, 10.3cm high and 35.7cm deep — or 11.5 x 4 x 14 inches, if you prefer. The prototype case is made from 20 gauge steel, and is finished in chocolate hammertone lacquer.

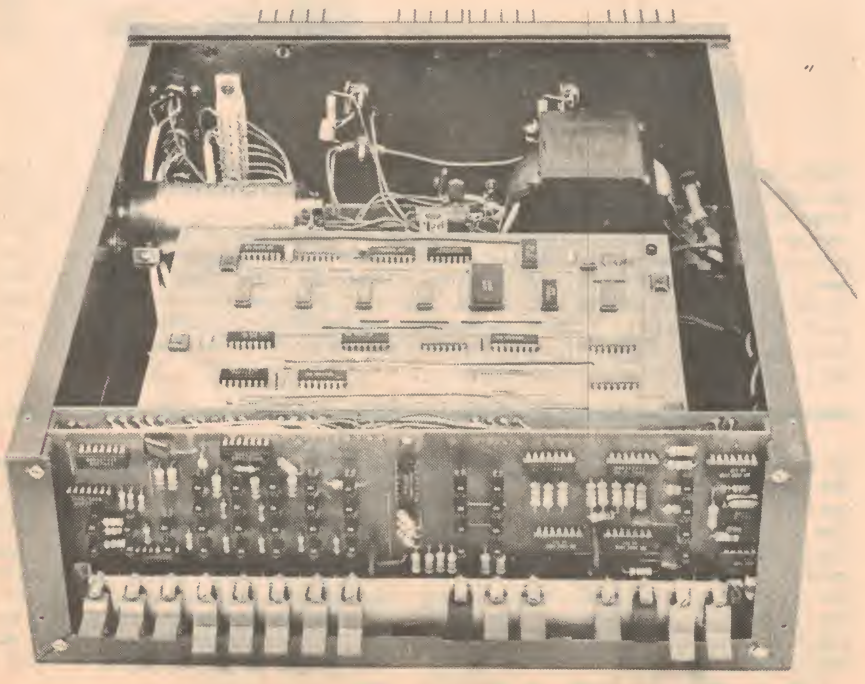
The case is made in two sections, with the main section forming its base, sides and rear. The front and top are provided by the second section, which is designed to slide on from the front. Once assembled the two are held together by a lip at the rear and by four small self-tapping or "PK" screws.

No components whatever are mounted on the front panel-top section of the case, which serves purely as a cover and control escutcheon. This has been done deliberately, so that the machine may be operated easily with the cover removed, to facilitate servicing.

The power supply wiring of the machine is built into the rear of the case, with the two series-pass power transistors and their finned heatsinks mounted on the case rear itself. Also mounted on the case rear are the sockets for interconnection with the input and output devices.

The actual computer proper is an assembly of printed wiring or "PC" boards, mounted in the front section of the case. Two of the PC boards are mounted vertically, spaced behind the plane of the case front panel by about 2cm and 3cm respectively. The remaining six boards plug into edge-connector sockets mounted on the second of the two vertical boards, to form a vertical stack array.

The vertical board nearest the front panel plane performs all of the wiring and interconnections between the front panel components — console switches, LED indicators and so on. For fairly obvious reasons it has been dubbed the "front panel board". The second vertical board makes virtually all of the interconnections between the plug-in PC board sockets, and is known as the "mother board". The copper etching patterns for these two boards are coded E8/F and E8/C respectively; both measure 28.3 by 9.5cm.



A view of the machine with the top/front panel removed. Note that the front panel board visible is an early version.

In vertical order from the top down the plug-in boards respectively provide the circuitry for the run control, major state generator and timing pulse generator (E8/T); the instruction register and decoder (E8/D); the memory, memory address and memory buffer registers (E8/M); the program counter and serial adder (E8/P); the accumulator (E8/A); and the input-output interfacing circuitry (E8/10T). Each of these six boards measures 21.5 by 16cm, and the etching pattern codes are as shown in the brackets.

Space has been left in the case so that the plug-in PC boards may be easily removed or replaced. The space also allows any one board to be "extended out" for convenient access during operation, by means of an extender board. This is simply a PC board with etched contacts along one end, with conductor strips connecting these to the pins of edge connector sockets mounted at the other end. Thus by plugging the extender board into the computer mother board socket(s) normally occupied by a board, and plugging the board in turn into the extender board sockets, the board is brought out for convenient access while leaving it still connected into circuit. The extender board measures 24.5 by 18cm, and its pattern is coded E8/X.

To remove a board and replace it with the extender board, the boards above it must be temporarily removed to allow access. The desired board is then removed, and replaced by the extender board — with the sockets on the latter facing upward. The other boards can then be replaced, and finally the displaced board plugged into the sockets on the extender board. It then protrudes vertically from the board stack, allowing ready access to both sides.

With the exception of the extender board, which is made from normal SRBP, all of the PC boards in the prototype are made from epoxy fibreglass laminate, and this is probably preferable in view of its greater

It's growing!

Due to the falling prices for memory ICs, it is now possible to provide EDUC-8 with a 128-word memory at virtually no more than the original cost of the 32-word version. In view of this we are modifying the design, so that as actually described EDUC-8 will have a 128-word memory — four times the original size. Provision is also being made for expansion to 256 words, if desired.

strength. However it is also a good deal more expensive than SRBP and the newer fireproof bakelite laminates, both because of the higher cost of the laminate itself and because it is tougher on drills. Whether this extra cost is really justified is a moot point.

Largely for emotional reasons rather than objective, fibreglass boards have become traditional for "serious" projects such as this, and there will no doubt be some who will want to obtain the boards made from this material regardless of cost. However if you're a little daunted by the cost, I don't by any means suggest that you should regard fibreglass as essential. Provided that they are handled with reasonable care, SRBP boards should be quite satisfactory.

I do suggest, though, that you get boards which are gold flashed — at least along the edge connector pads. This will make for very much more reliable connections, and is well worth the small additional cost involved. An electro-deposition process, gold flashing gives the copper pads a coating of gold which is thinner than the more expensive plating, but entirely adequate for this sort of situation where the boards are not going to be repeatedly removed and replaced.

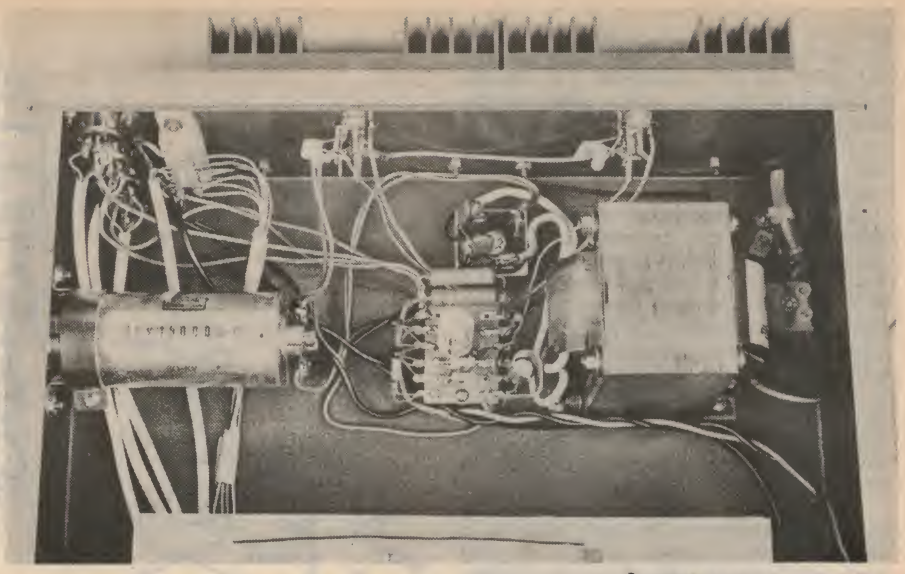
Probably the best place to start construction of the computer is with the power supply, as this can then be used to power the other sections as they are built up. Apart from having the psychological appeal of letting you produce some working circuitry early on, it will also allow you to check the operation of the various boards as they are completed. The order in which the boards will be described has been deliberately arranged so that this "checking as you progress" technique can be exploited as much as possible.

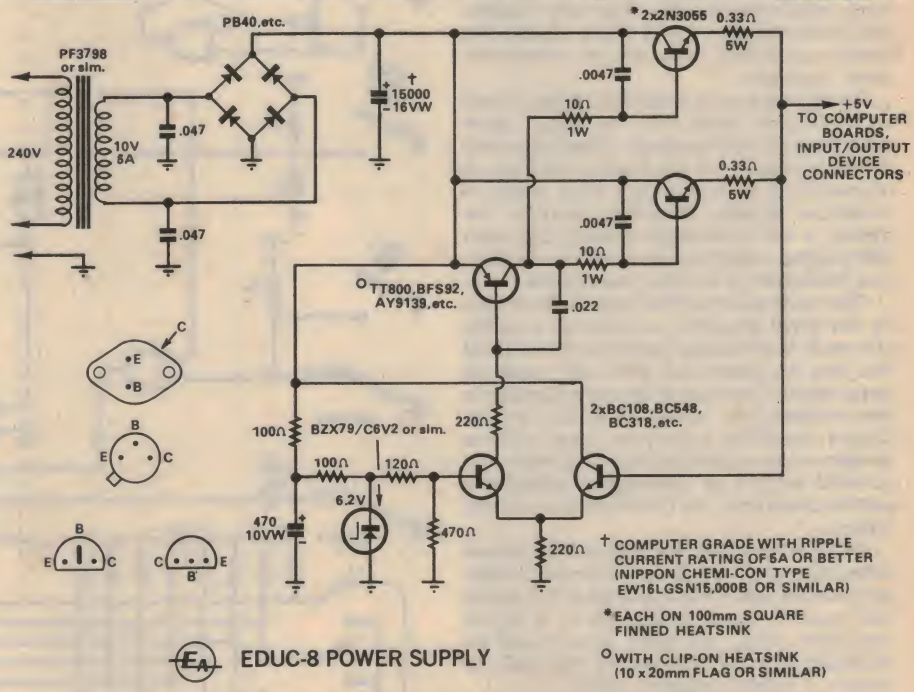
As you will perhaps have noticed already, the power supply circuit is very conventional, its only noteworthy aspect being that it has been designed to deliver up to 6 amps at a nominal 5V. It uses a conventional bridge rectifier, driven by a suitably rated 10V stepdown transformer. The rectifier bridge is of the type having four high-current silicon diodes mounted in a single package, such as the EDI type PB40.

The reservoir capacitor should have a value of at least 15,000uF, to cope with the heavy drain. It should also have a ripple current rating of at least 5A, for the same reason. Generally this means that we are talking about a "computer grade" electro, with a suitably impressive price tag. However as this is the main reservoir electro for the whole machine, it is worth getting the best you can afford.

There are three types available at the time of writing which appear to be quite suitable. These are the Nippon Chemi-con type EW16LGSN-15,000B, available fron Allied Capacitors; the type ELL-52052, made locally by Plessey Australia; and the type B41455 from Siemens Industries. The first of these is 15,000uF, while the other two are 22,000uF. All are single-ended clamp mounting types.

The regulator circuit uses conventional discrete transistors, rather than an IC. This has been done partly because there have been, and still are to a certain extent, supply problems associated with some of the most suitable regulator ICs. A further reason is that I have found it rather difficult to come up with a 6 amp regulator circuit using an IC, which is as stable as this simple discrete circuit, without going to considerably greater complexity and cost.





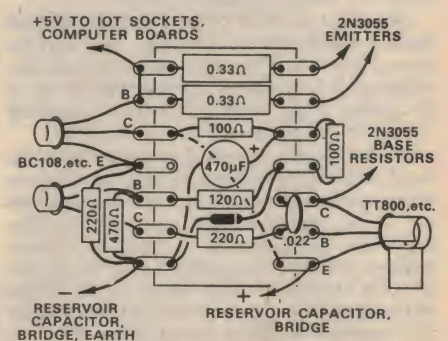
† COMPUTER GRADE WITH RIPPLE CURRENT RATING OF 5A OR BETTER (NIPPON CHEMI-CON TYPE EW16LGSN15,000B OR SIMILAR)

*EACH ON 100mm SQUARE FINNED HEATSINK

°WITH CLIP-ON HEATSINK (10 x 20mm FLAG OR SIMILAR)

EDUC-8 POWER SUPPLY

At top is a close-up shot of the power supply and IOT connector wiring, with the circuit of the power supply above. At right are details of the wiring on the small power supply resistor panel.



There are only five transistors used, with two 2N3055 power devices in parallel as the series pass element. These are driven by a medium power TO-5 PNP driver device, which is driven in turn by two low power NPN devices acting as the error amplifier. The reference source is provided by a 6.2V zener diode, this voltage being close to optimum from the point of view of temperature coefficient. A simple resistive divider across the zener establishes the nominal 5.2V reference against which the output of the regulator is compared.

The two 0.33 ohm resistors in series with the 2N3055 emitters are swamping resistors, to ensure that the two devices share the load current equally. The two 10 ohm series base resistors with their associated 4700pF collector-base capacitors, together with the .022uF capacitor across the driver are to ensure that the regulator is stable for all normal load impedances. Without these components to "throttle back the gain" at high frequencies, this sort of circuit can become a very effective oscillator with capacitive loading, due to the excellent gain-bandwidth product of the silicon transistors!

The two .047uF capacitors bypassing either side of the power transformer secondary are for RFI filtering, incidentally. Without them, the operation of the machine

can be disturbed by mains switching transients and other rubbish which can find its way in via the transformer. The filtering provided by the two simple bypasses has been found quite effective, and no further protection should be necessary providing your machine is housed in a similar earthed metal case.

Despite the simplicity of this power supply circuit, its performance is quite good. Output voltage drops by only 0.12V when the load current is changed from 500mA to 6 amps, which is more than adequate for this sort of application. Similarly the output ripple is well down, being less than 50mV peak to peak even at the nominal full load current of 6A. This means that the supply is easily capable of delivering the nominal 3 amps required for the basic computer, with another 3 amps available for powering the logic in peripherals.

Incidentally this supply would perhaps be worth considering in its own right as a general-purpose heavy duty 5V supply for logic development work. It is fairly rugged, and will even take direct shorts across the output providing they are of reasonably short duration.

As there are only a handful of parts used in the supply apart from the larger components such as the power transformer and reservoir electro, it has been wired up in conventional fashion using a small length of miniature tagstrip. Needless to say, the wiring is not particularly critical, the main thing being to wire up the leads carrying the full load current in fairly heavy wire.

The basic wiring of the tagstrip is shown in the small diagram, to serve as a guide. The rest of the power supply wiring should be easy to work out from the close-up photograph. The two series-pass transistors are mounted on individual 10-cm square finned heatsinks, using the usual silicone grease, mica or plastic insulation shim and sleeved screws to electrically isolate the device cases from the heatsinks and earthed frame.

Don't forget that the mains flex should enter the case through a grommetted hole, be clamped upon entry, and have the active and neutral wires terminated in a screw connector strip. The earth wire should be soldered to a lug screwed to the case, to ensure a reliable machine earth.

Note that the PNP driver transistor should have a small clip-on heatsink. This can be one of the fancy moulded types if you like, although a few square centimetres of 18 or 20 gauge sheet brass bent into a suitable "flag" or "9" shape will do just as well.

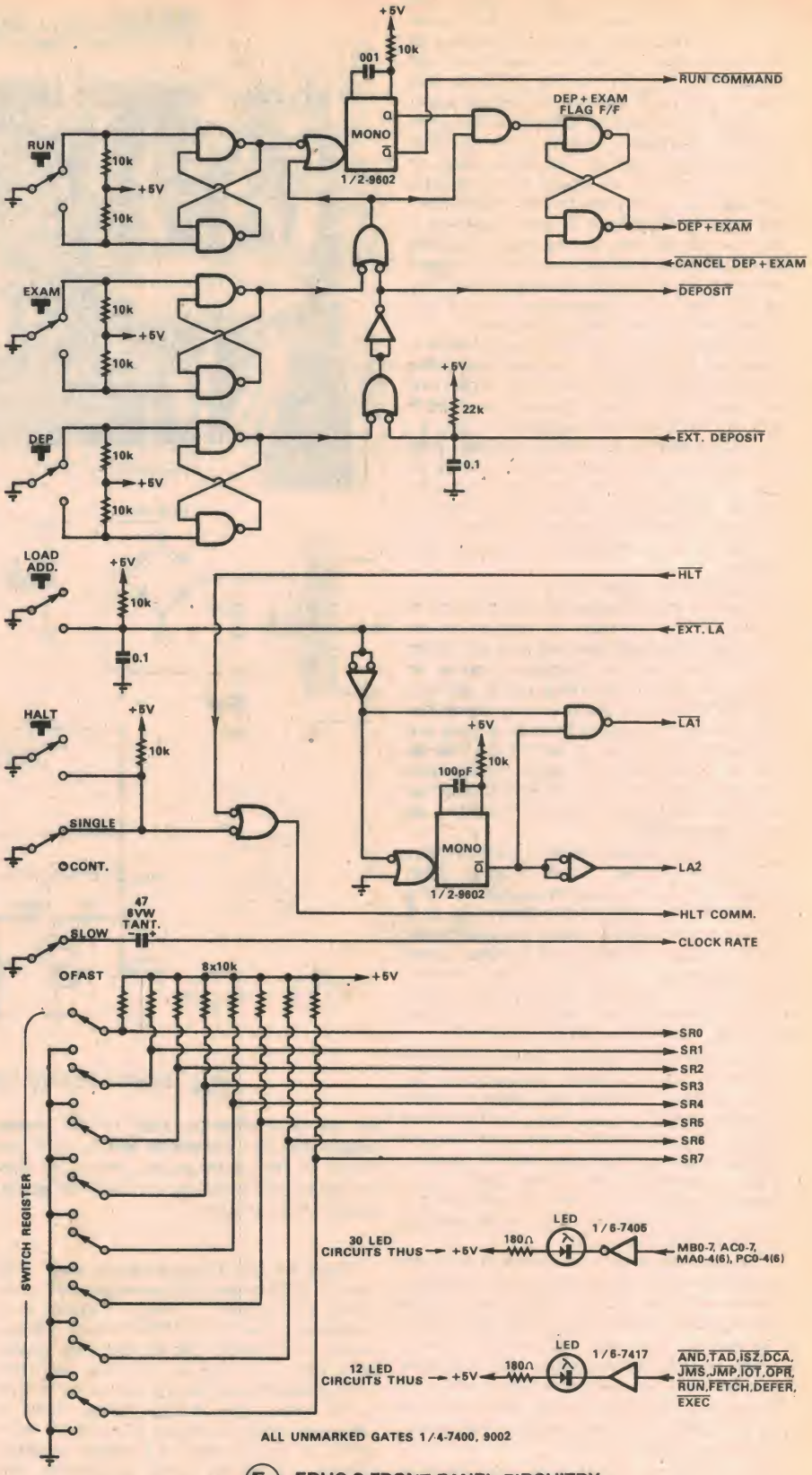
As soon as the supply is wired up and you have checked to make sure that no obvious errors have been made, it can be switched on — or "powered up", to use the appropriate computerese — and its output voltage checked. Regulation and ripple can also be checked if you have the facilities, although if the open-circuit output is right the rest will probably be in order also.

As with most simple supplies, the open circuit voltage tends to be a little higher than when even a small load current is drawn. It should measure between about 5.3 and 5.4 volts, dropping to about 5.12V at about 500mA drain and then dropping much more slowly to around 5.00V at 6A. If your supply is consistently higher or lower than these figures, the cause will almost certainly be due to the zener tolerance.

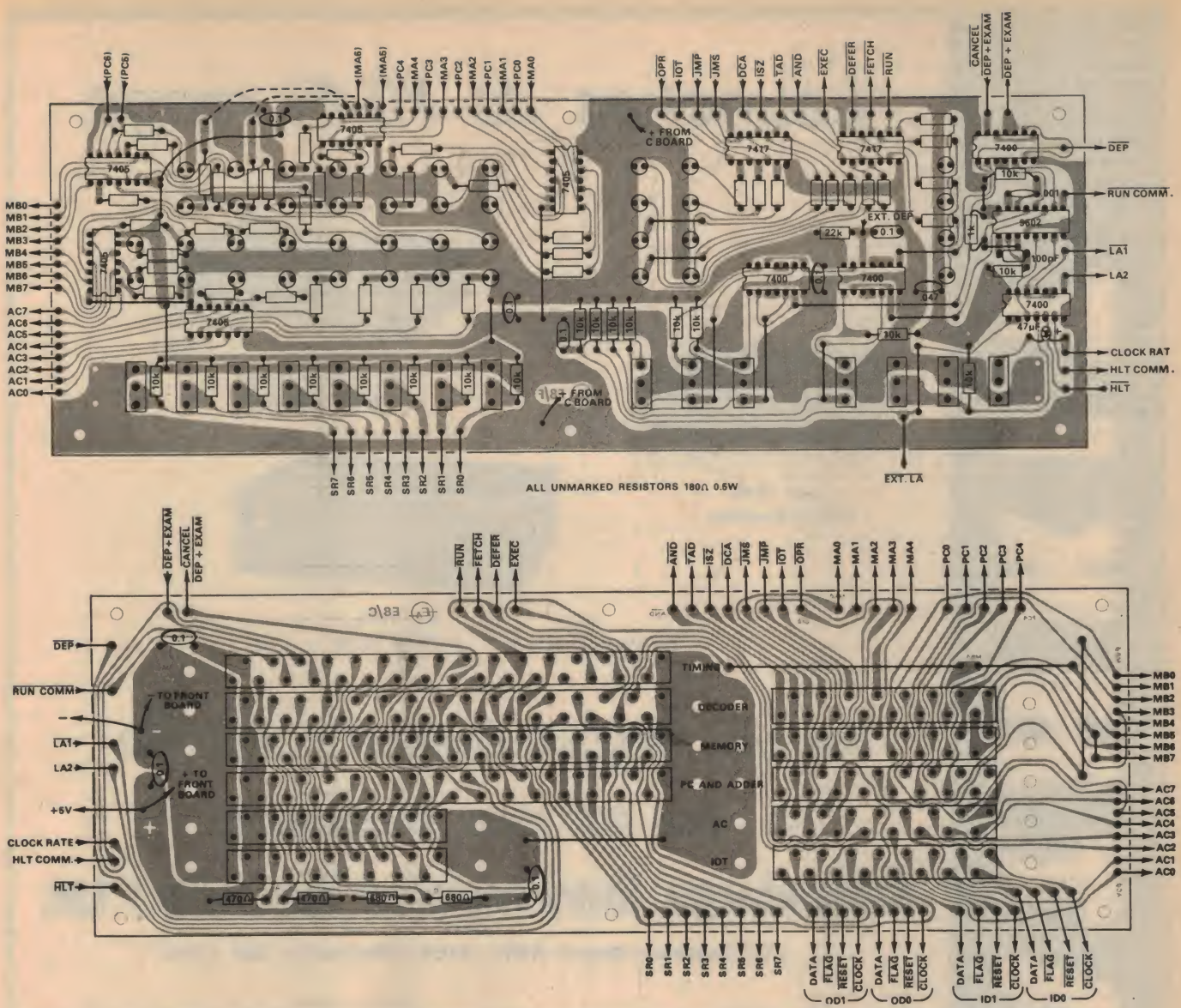
The remedy is simple: adjust the value of either the 120 or 470 ohm resistors across the zener, using higher value shunt resistors, until the desired voltages are produced. Pad down the 120 ohm resistor in this way if the voltage is low, or the 470 ohm resistor if the voltage is high.

With the power supply operational, you will then be in a position to start on the actual computer itself. I suggest that you begin with the front panel board, as this will let you see how the finished machine is going to look. And with the board completed and hooked up to the power supply, you will have an impressive array of lights and switches to demonstrate your progress to others!

The circuitry which is associated with the front panel board is shown in the diagram,



EDUC-8 FRONT PANEL CIRCUITRY



Above are wiring diagrams for the front panel board (top) and the mother board, showing all parts and interconnections.

and as you can see it is not particularly complex. Seven of the ICs used are hex inverter (7405) or hex buffer (7417) devices, whose elements are used to drive the 42 LED indicators. The two different circuits used for the LED drivers are shown down in the lower right of the diagram, with a legend showing which signals use each version. Basically those signals available in positive logic form use the inverter element drivers, while those in negative logic form use the non-inverting buffer drivers.

Immediately above the LED drivers in the diagram is the switch register, which is simply eight switches and the same number of 10k pullup resistors. This is a simple way of generating static high or low logic levels, and is all that is required. No suppression of contact bounce is required, as the switches are not involved in dynamic operation.

The remaining front panel circuitry is that associated with the control switches. This uses four low cost 7400 or 9002 quad gates, together with a 9602 dual monostable or "one-shot".

The three control switches which initiate running of the machine — the RUN, EXAMINE and DEPOSIT switches — are fitted with bounce suppression flip-flops which each use two 7400 gates. These ensure that only a single, clean level transition occurs whenever these switches are pressed or released.

One of the 9602 one-shot elements is used to sense whenever one of these three switches is pressed, and to generate a single pulse in response. This pulse becomes the RUN COMMAND signal (negative logic), which is sent to the timing and control board to set the run flag flip-flop and start the machine running.

This is the only immediate outcome of pressing the RUN switch, as far as the front panel circuit is concerned. However in the case of EXAMINE or DEPOSIT, the output from the one-shot is also combined with the "OR" signal from the debouncing circuits to set a small R-S flip-flop labelled the "deposit or examine flag".

The output of this flip-flop becomes the DEP + EXM logic signal (negative logic), which is used throughout the machine to distinguish an examine or deposit cycle from normal running. Similarly the output signal from the deposit debouncing circuit is also taken away as a further logic signal, to distinguish deposit from examine.

Note that provision has been made for a deposit cycle to be initiated by an external negative logic signal, as an alternative to depressing the front panel switch. This has been done to permit convenient loading of programs by means of "hardware loader" logic in an input device such as a paper tape reader.

Before a program can be fed into the machine by a sequence of deposit cycles, or checked by a sequence of examine cycles, its starting address must be loaded into the program counter (PC) register. The same operation is also necessary before the program can be set running, in order that the first instruction fetched will be the correct one.

This function is performed by the LOAD ADDRESS key, which as may be seen generates a negative logic signal by simply shorting the lower end of a 10k resistor connected to the 5V line. Provision has also been made for the same function to be performed remotely, by what effectively becomes an external negative logic LOAD ADDRESS signal.

In either case the resulting negative logic signal is inverted and used to generate two signals which are fed to the PC register to cause it to be loaded by the logic levels present on the switch register output lines

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SRO-6 inclusive (or SRO-7 inclusive with the extended memory). The two signals are LA1 (negative logic), which is used to clear the PC, and LA2 which is used to perform the actual loading.

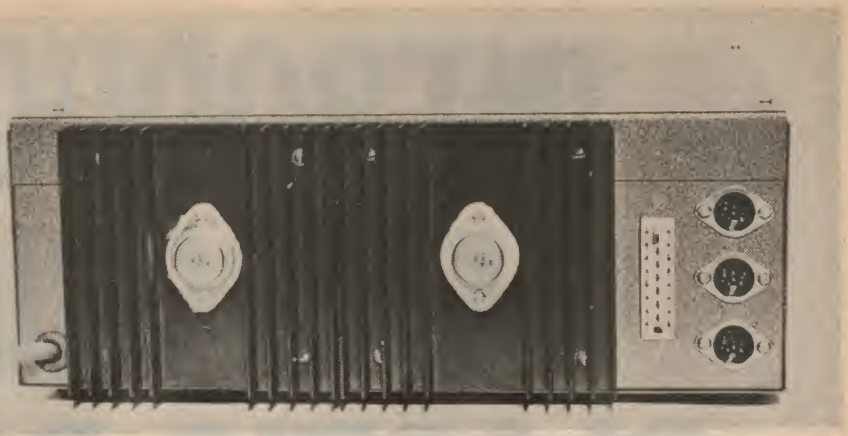
As may be seen, the circuit which produces the two signals is quite simple, using a two-input gate, the second one-shot element from the 9602 device, and a further gate used as an inverting buffer. The one-shot is arranged to trigger only on negative-going edges of the inverted (and therefore positive logic) LA signal, so that if the load address key switch were bounceless the one-shot would not operate until the key were released.

If we ignore bounce for a minute, then, it can be seen that the Q-bar or complementary output of the one-shot will remain in the high logic state while the LA signal is present, because the one-shot will not yet have triggered. As a result the gate producing the LA1 signal will have two high outputs, and will produce the signal to clear the PC register.

Then, when the key is released, or the external LA signal removed, the input of the gate connected to the LA signal will go low, causing the gate output to go high and thus inhibiting the LA1 signal. But at the same time the one-shot will trigger, causing the Q-bar output to go to the low state for a short time. As a result the inverting buffer attached to this output will produce the LA2 pulse signal, causing the address set up on the switch register to be loaded into the freshly cleared PC register.

Although you might think that this neat chain of events would be fouled up by contact bounce in the LOAD ADDRESS key, this isn't so. If you trace through the circuit, you'll see that the only effect of bounce is to cause the sequence to be repeated a number of times in rapid succession. And because the last "bounce" after the key is released will always by definition cause a negative-going transition at the input of the one-shot, the last event will always be the generation of an LA2 pulse. Hence despite bounce, correct loading always takes place.

It is because the load address circuit is unaffected by bounce that the LOAD ADDRESS key is not provided with a bounce suppression flip-flop as fitted to the RUN, EXAMINE and DEPOSIT keys. There is no point in having a flip-flop if it is not necessary.



The rear of the case, showing the IOT connectors and regulator transistors.

One of the three remaining switches on the front panel board is the SLOW/FAST switch, which in the slow position completes the earth return circuit of a 47uF tantalum electrolytic capacitor. The other end of the capacitor connects to the main clock pulse generator on the timing board, to alter its operating frequency.

The remaining two switches are the HALT key and the SINGLE/CONTINUOUS switch, which as may be seen are both in parallel. Both have the effect of producing a low logic level at one input of a gate acting as an OR element, to produce a logic signal labelled HALT COMMAND. The second input of the OR gate is fed from the HLT instruction output line (negative logic) of the instruction decoder, so that the same HALT COMMAND signal is generated in the event of a "halt" instruction.

The effect of the HALT COMMAND signal is to cause a reset pulse to be fed to the run control flag flip-flop in the timing circuit, at the beginning of the second half of T23 of the next EXECUTE cycle. This in turn causes the main run control flip-flop to the reset at the end of T23, so that the machine stops running after fully completing the current fetch-execute cycle.

The run control flag flip-flop can only be reset during T23 of an execute cycle, and then only if the HALT COMMAND single is present. This has a number of implications, some of which will be discussed later. One implication is that it is quite in order for the RUN and HALT keys to be pressed at the same time — contradictory though this may sound. Since the HALT key is effectively only sensed during T23 of the execute cycle, pressing both keys together and holding them both down simply couses the machine to run for a single complete fetch-execute (or fetch-defer-execute) cycle.

In other words, it performs a single instruction step — nothing more, nothing less. So that if the HALT key is held down continuously and the RUN key pressed repeatedly, the machine will simply step through a program one instruction at a time. This can be very handy for analysing the operation of a program — particularly if it is not doing what you expected!

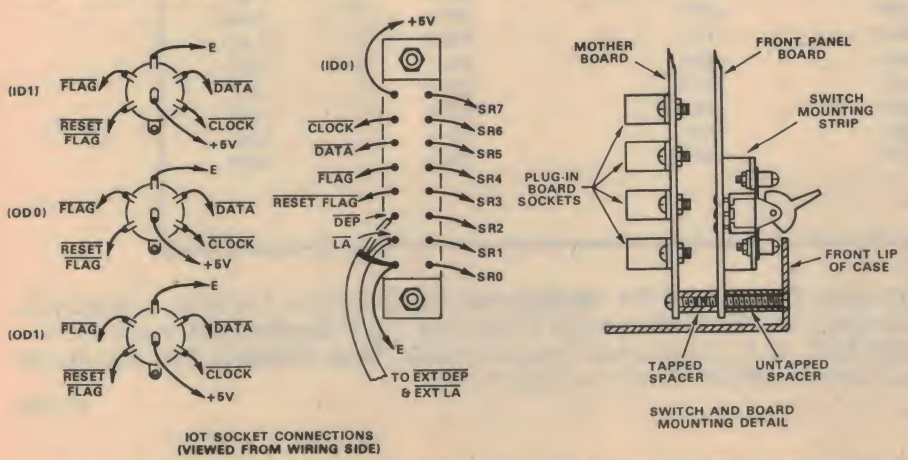
It can be rather tedious having to hold the HALT key down for any length of time, though, and this is why the SINGLE/CONTINUOUS switch is provided. In the single step position, it is simply equivalent to holding the HALT key down all the time — but a little easier on the operator's finger.

Wiring of the front panel board should be found a fairly straightforward task, if you use the wiring diagram as a guide together with the circuit and the photograph. Most of the wiring should be fairly self explanatory, although care should be taken with such matters as correct orientation of the indicator LEDs and the various ICs.

Note that provision is made on the board for indicator LEDs corresponding to bits 0-6 inclusive of the PC and MA registers. This is sufficient for the 128-word memory, where only 7 address bits are used, but will not allow indication of the eighth bits (PC7 and MA7) which become active if the memory is expanded to 256 bits. Indicators for these bits will be described later.

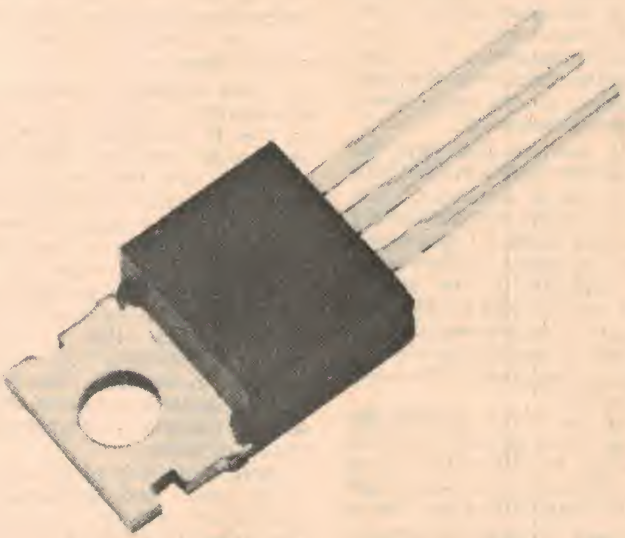
Probably the only other point to mention about the front panel board at this stage concerns the mounting of the switches. To enable these to be replaced individually at some future time, if they become faulty, they have been mounted on a small metal strip, which is attached to the front of the PC board via small screws and nuts, at each end. The switches are fastened to the strip from the front using the screws and nuts supplied with them, and with their bodies passing through clearance slots. Finally their rear lugs pass through holes in the PC board, and are soldered to the appropriate copper pads.

This technique should allow any of the switches to be removed later on if necessary, by undoing its mounting screws



At left are the IOT connector wiring details, and at right the switch and vertical board mounting arrangements.

INTRODUCING FAIRCHILD PLASTIC POWER



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2N 6122	60V	40W	NPN	0.44
2N 6123	80V	40W	NPN	0.49
2N 6124	—45V	40W	PNP	0.45
2N 6126	—80V	40W	PNP	0.53
2N 6129	40V	50W	NPN	0.56
2N 6130	60V	50W	NPN	0.63
2N 6131	80V	50W	NPN	0.69
2N 6132	—40V	50W	PNP	0.63

Sydney: George Brown 519 5855; Warburton Franki 648 1711. **Melbourne:** Browntronics 419 3986, Warburton Franki 69 0151. **Adelaide:** Gerard & Goodman 223 2222, Warburton Franki 356 7333. **Queensland:** Warburton Franki 52 7255. **A.C.T.:** George Brown 95 0455. **W.A.:** Warburton Franki 61 8688. **New Zealand:** Tee Vee Radio, Auckland 763 064, Wellington 60 523, Dunedin 88 028, Christchurch 67 748.

FC.8011

ar unsoldering its lugs using a small instrument iron introduced between the front panel and mother boards. A little tricky, to be sure, but not too difficult. The small diagram shows the arrangement.

There is little to say about the mother board, particularly in terms of its circuit function, because its main function is to perform all of the interconnections between the socket pins of the various plug-in boards.

Apart from this very necessary and worthwhile function, it also brings out the connections between the plug-in boards and the front panel circuitry, and between the IOT board and the input-output device sockets. It also reticulates the 5V supply power, and mounts the four resistors used to terminate the A,B,C and D data bus lines.

Whereas the twin PC edge connectors used for all of the lower boards have their "inner" ends open, to clear the board, the single top board socket has both ends closed.

The wiring of the mother board should again be fairly evident from its wiring diagram. The connections between it and the front panel board are all marked identically, so that when the two boards are wired up and mounted together via six half-inch tapped spacers, it is simply a matter of joining up the pads with the same markings. In many cases these are exactly opposite one another, so that interconnection involves only a short length of tinned copper wire bridging the gap. Where this has not been possible, the pads are generally in the same order, but merely a little further along so that a short length of hookup wire will be needed.

The only exceptions to this rule are the connections to the PC and MA indicators, which are separate on the mother board but interleaved on the front panel board. This is a little more tricky, but if each is wired separately and with care, all should be well. Note that there are no pads on the mother board for the PC and MA register bit 5 and bit 6 indicators — these will be dealt with separately, at a later stage. For the present leave the pads unconnected.

Note that there are four groups of four pads at the bottom of the mother board, which provide the input-output device signal interconnections. These should be connected to the appropriate rear panel sockets, using the small connection diagram as a guide. There are three small 6-pin DIN sockets, two of which are used for the output devices while the third is used for input device 1 (ID1).

A larger 16-way socket is used for input device 0 (ID0), and the other pins of the socket are connected to the switch register pads SRO-7, the external deposit pad and the external load address pad — the last two being on the front panel board. This allows the ID0 socket to be used for input devices incorporating a hardware loader, such as a paper tape reader. Note that the external DEPOSIT and LA connections between the socket and the front panel board should be made in twin shield wire, to prevent possible malfunction due to spurious pickup.

In addition to control and data signal connections, each input-output device socket also receives 5V supply power direct from the regulator output. This avoids trouble due to supply bus transients.

The 5V supply connections to the mother and front panel boards should be wired in fairly heavy leads, to ensure low voltage drop. The stranded-conductor leads from a length of 3-core plastic insulated mains flex are quite suitable.

The mother board-front panel board assembly is mounted into the main case by four ⅛in Whitworth by 1 inch countersink-head screws, two at each end in the corners. The screws pass through countersunk holes in the wide turnover lips at the front of the case, and are then fitted with clearance spacers approximately ¾ inch long. When the board assembly is in position, the screws then pass through the holes in the front panel board, and mate with the tapped holes in the spacers between the two boards. Tightening the screws carefully thus completes the assembly of the two boards, and also fixes them rigidly behind the final plane of the front panel.

With these boards wired up, connected to the power supply and mounted in the case, you can power up again and check progress. It won't be easy to check the operation of the control switches at this stage, but you can certainly check the LED indicator circuits and the operation of the switch register switches.

When you switch on, all of the register indicator LEDs on the left-hand side of the front panel board should light, while the rest should all remain dark. Then, with a piece of hookup wire with one end connected to power supply negative (ie, the case), it should be possible to turn off each of the register LEDs by touching the appropriate interconnecting link with the wire.

With the same wire it should be possible to light up any of the normally dark LEDs, by touching their interconnection links or pads.

If any of the register LEDs don't come on when power is applied, look for a wiring error. The most likely cause will be a LED wired in the wrong way around. Failing a wiring error, you could have a faulty LED or IC, which will have to be replaced.

Similarly if any of the instruction indicator or machine state LEDs on the right-hand side of the board can't be turned on by earthing the input of their buffer, again look for a wiring error or a faulty component and remedy it as soon as possible.

Finally, you can check the operation of the switch register by temporarily connecting its inter connection pads to the input pads of one or more of the register indicator drivers. You can do this either one switch at a time, or all at once — say by connecting them to all of the MB or AC register drivers. In the up position each switch should cause its indicator LED to light, while in the down position the LED should be extinguished.

Barring a faulty switch or pullup resistor, all should be well at this stage. You should now be ready to tackle the timing and control board, which will be the next section described.

EDUC-8 PARTS LIST — 1

MAIN CASE AND POWER SUPPLY

1 Case and lid/front panel, 29.3 x 10.3 x 35.7cm (W x H x D), with switch mounting bracket.
1 Power transformer, 240V/10V at 6A (Ferguson type PF3798, Jones type JT 139 or similar)
2 10cm square finned heatsinks, flat mounting type.
3 6-way DIN sockets (McMurdo type 1290-06-01)
1 16-way polarised plug and socket (McMurdo type 1338-12-02, 1338-02-02)
1 Silicon rectifier bridge, PB40 or similar
2 2N3055 NPN power transistors with mounting accessories
1 TT800, BFS92, AY9139 or similar medium power PNP silicon
2 BC108, BC208, BC548 or similar general purpose NPN silicon
1 BZX79/C6V2 or similar 6.2V 400mW zener diode
2 4700pF LV polyester or polycarbonate
1 .022uF LV polyester, etc
2 .047uF LV polyester, etc
1 470uF 10VW electrolytic
1 15,000uF or 22,000uF 16VW electrolytic with mounting clamp
Resistors: 2 x 0.33ohm 5W, 2 x 10ohm 1W, 2 x 100ohm ½W, 1 x 120ohm ½W, 2 x 220ohm ½W, 1 x 470ohm ½W
Mains cord and plug; grommet and clamp for same; 2-way "B-B" connector strip; 7-lug section of miniature resistor panel; 2 x 2-lug miniature tagstrips; 2 x 12.7mm tapped spacers; rubber feet for case; screws, nuts, washers, solder lugs, etc.

FRONT PANEL BOARD

1 Printed wiring board, code E8/F (28.3 x 9.6cm)
8 SPDT paddle switch, red paddle (C&K type 7101)
2 SPDT paddle switch, grey paddle (C&K type 7101)
3 SPDT spring return paddle switch, red paddle (C&K type 7108)
2 SPDT spring return paddle switch, black paddle (C&K type 7108)
4 spacers, untapped, 17mm long
4 7400 or 9002 quad gate
5 7405 or 9017 hex inverter (open collector)
2 7417 or 9N17 hex buffer (open collector)
1 9602 dual one-shot
42 Low cost red LED's single ended type (OLD419, FLV110, 5082-4850, 5082-4484, SL103, CQY24 or similar)
1 100pF NPO ceramic capacitor
1 .001uF LV polyester or polycarbonate
6 0.1uF LV polyester or polycarbonate
1 47uF 6VW tantalum electrolytic
Resistors: 42 x 180ohm 1/4W, 1 x 1k 1/4W, 18 x 10k 1/4W, 1 x 22k 1/4W
Mounting screws for switch bracket; hookup wire for links; solder, etc.

MOTHER BOARD

1 Printed wiring board, code E8/C (28.3 x 9.6cm)
4 32-way edge connector sockets, gold PC tail clips (McMurdo type 133-14-17) One socket closed both ends (closed end foot type 4862-01-08)
7 16-way edge connector sockets, gold PC tail clips (McMurdo type 133-12-17)
3 0.1uF LV polyester or polycarbonate capacitors
2 680ohm 1/4W resistors, 2 x 4700 ohm 1/4W resistors
Hookup wire for links, connections to front panel board IOT connectors and power supply; 6 x 12.7mm tapped spacers for assembling boards; screws, etc.

Forum

Conducted by Neville Williams

Economical approach to surround sound

Full-scale quadraphonic systems are fine — if you have the ready cash to outlay and the space to accommodate them. But, according to a correspondent, it is possible to get a "surround" effect much more simply, for the price of two oddment loudspeakers, two wirewound pots and a few feet of wire.

The particular letter comes from a country reader who has this to say:

Dear Sir,

I've followed your articles on quadraphonics with great interest but here in the "sticks" there isn't any way of hearing actual 4-channel sound. I tried hooking up a pair of Rola 6-0 for ambience sound following the Hafler-Dynaco system but found that for low-level listening it leaves a deal to be desired. Like many another husband, I'm restricted as to the actual wattage the outfit is allowed to dissipate so everything must be geared to low levels!

You may recall that some 10 years ago theatres (motion picture variety — yes I'm an ex-operator), used what they termed "Audience Participation" speakers along the walls of the auditorium fed from a "special effects amplifier" to provide "surround sound". It wasn't the most popular here, many of the gentler sex being downright critical; but nonetheless with 4-track magnetic sound tracks they did create an illusion. It's that latter part — the illusion that I've worked upon.

I'm using a pair of Magnavox 8/30 enclosures with the 1" Philips dome tweeters (8-ohm) and feeding them from a Classic tuner/amp. It's about 6 years old and has 15-ohm output but, at the levels required, the performance is fair enough. To create the ambience effect I've merely hooked the Rola 6-0's (also 8-ohm) in series with the Magnavox, and shunted the Rolas with a 20-ohm pot to act as volume setters.

In our lounge room it seems to be better to correctly phase all speakers and to "pair" the sides or it sounds a bit thin. I.m using 8-ohms for the day when I update to "solid state" but, at the moment, it does give a surround sound which is most pleasant. On the grounds of "not knocking it unless you've tried it", "suck it and see". The Rolas have been placed up about picture rail height and I've provided a cut-out at the bottom of the box to allow for the back-wave of the cone. The local radio station 3MA is using Ortofon heads and, other than the highs are restricted, their discs sound quite acceptable.

J.M. (Mildura, Vic.)

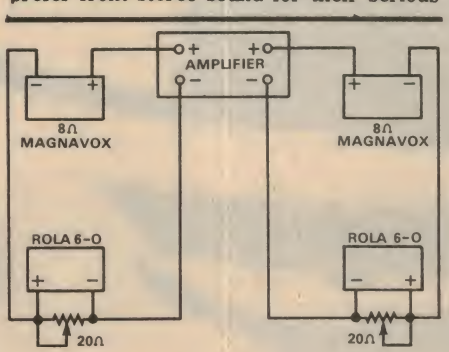
While we are quite happy to comment on the idea, we didn't accept J.M.'s challenge of "not knocking it unless you've tried it" But then we don't particularly want to knock it. It's just that we've played around with so many loudspeakers in so many configurations over so many years that we know fairly well what to expect.

While J.M. is using four loudspeakers, this is the only thing his circuit has in common with the recognised quadraphonic systems — so let's not get confused on that point. Technically, it is equally as far removed from the additional sound tracks and amplifiers involved in the special films to which he refers.

What J.M. is really saying is that, method notwithstanding, he likes the feeling of being surrounded by sound rather than having it dispensed from distinct source(s) against one wall of the listening room.

There is nothing new in this. Many people who respond emotionally to popular music (variously described as beautiful, lovely, sweet, atmospheric, mood, schmaltz, etc) like to be surrounded by it. For this same reason, those who dispense background music in shops and offices seek to achieve a low-level all-pervading sound.

People who don't like this approach tend to be those who listen to music primarily as a performance; for them, it should emanate from one identifiable point or area appropriate to the occasion. That is why classical music lovers, as a class, tend to prefer front stereo sound for their serious music, regarding it as both adequate and appropriate.



J.M's formula for inexpensive "surround" sound probably hinges on the use of distinctly different loudspeakers. But it raises some interesting side issues, which are mirrored in the discussion of the Leslie Plus 2 system referred to elsewhere in the issue.

But it's easy to be snooty about this. Speaking personally, while there are occasions when I deliberately turn down the rear speakers of my own quadraphonic system, most of the time it is set for "surround" type sound — because I like it that way. And being involved in the industry, it is relatively easy for me to indulge the fancy.

Not everyone is so fortunately placed in this respect and it is reasonable to speculate on how some kind of surround effect may be achieved, without going to the expense of a full-scale 4-amplifier 4-loudspeaker system.

One approach, as mentioned by J.M. is to use the Hafler systen which applies a composite sum and difference signal to two rear loudspeakers. The system works well, provided the objective is to replace the acoustically dead back wall with a system which provides some sound ambience and even the occasional transplant of the apparent sound source.

But, as a way of providing full-scale surround sound for a central listening position, the scheme is less successful — mainly because the energy available to the rear loudspeakers is always less than that to the front ones. By using more sensitive rear loudspeakers and providing a means of critically controlling their level, a reasonable result can be obtained but the scheme obviously lacks the flexibility of separate rear amplifiers and a comprehensive balance control system operating in the signal path.

Another approach is simply to use an additional pair of loudspeakers connected in parallel with the existing stereo pair, but placed along the sides of the room or to the rear of the listening position. Level is not a problem in this case, since the same power is available to the original and additional loudspeakers.

But a problem does arise from the fact that each pair of loudspeakers is fed with the same left or right signal. The more alike the original and additional loudspeakers, the more does the ear tend to blend their output into a virtual image somewhere between the two. Thus the left image is shifted along the left wall, and right image along the right wall. The end result may not be all that different from moving one's chair closer to the original stereo pair!

As E. T. Canby pointed out in our last issue ("Stereo Bonanza") this is one of the problems of installations which provide only CD-4 decoding. On CD-4 they're fine but, when fed with an ordinary stereo signal, they can produce only double stereo which isn't as satisfying as listening to the same program passed through a matrix decoding system. No different signals are created to individualise the sound sources.

The approach suggested by J.M. evades this problem, virtually as a result of his efforts to keep it simple and inexpensive. His additional loudspeakers are quite different from the main stereo pair, both in themselves and in the way they are baffled. Inevitably most of the bass will come from the front systems but, over the rest of the spectrum, individual speakers will be dominant, depending on peaks and troughs in their response. In short, there will be a dispersion of the sound image along the left and right walls due to differences in the response of the two loudspeakers.

It is, in a sense, an "accidental" example of what might be achieved more elegantly by deliberate frequency division. But it also

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C60X	10W RMS	30Hz-17kHz
C80	20W RMS	35Hz-8kHz
C80X	20W RMS	35Hz-20kHz
C100	20W RMS	40Hz-11kHz
C100X	20W RMS	40Hz-20kHz
C12P guitar	30W RMS	55Hz-10kHz
C12P woofer	30W RMS	35Hz-10kHz
C12PX wide range	30W RMS	35Hz-13kHz
C12PX guitar	30W RMS	55Hz-13kHz
12U50	50W RMS	25Hz-11kHz
12UX50	50W RMS	40Hz-13.5kHz
MIDRANGE		
C6MR	20W RMS	450Hz-6600Hz
KC5MR	15W RMS	700Hz-14kHz
TWEETERS		
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X30 dome	—	3kHz-30kHz
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has some "hairy" aspects which would rule it out for the technical purist.

The first is that a series connection raises the impedance of the driving source seen by either loudspeaker, thus compromising loudspeaker damping. Instead of the main systems seeing a driving source of a fraction of an ohm — thanks to the negative feedback — they see a source of several ohms.

More than that, over the rest of the range, the varying impedance characteristic of each loudspeaker must affect the output from its series-mate.

Would such effects be noticeable? Isolated and examined one loudspeaker at a time, they almost certainly would be and this would debar the scheme from consideration as good practice.

But J.M. is not concerned about this. He obviously feels that, possible objections notwithstanding, the end result is more pleasing overall — even on mono sound where there is no stereo component to supplement it.

We have no urge to "shoot down" that subjective evaluation — as long as it isn't regarded as a method of obtaining four-channel reproduction!

Dear Sir,

I would like to refer to the idea for synthetic treble response on page 5 of the June issue. The article contains some "gooseberries...

Refer to column 1 about 5cm from the bottom: If you take the frequency range between 4.5 and 9kHz (which is exactly one octave) and divide it into 12 separate channels, each of these will be exactly one semitone wide. Thus every tone within each of these channels must fall within a half semitone of the tone generated in the middle of the channel.

To make the best use of the principle outlined, the channels could each be four semitones wide; only three such channels would be needed to cover the octave range from 4.5 to 9kHz'

J.S. (Canterbury, Vic.)

Which brings us around to an interesting point, and one that does concern matrix quadraphonic.

Statements have been published in a number of places which suggest that the main benefits of quadraphonic reproduction can be obtained very simply by using four similar loudspeakers connected to a standard stereo amplifier, but arranged in diagonal fashion. Thus, the left channel feeds the loudspeaker in the left front position but also one in the right rear position, diagonally opposite.

(Superficially, the idea would seem to be one that J.M. tried and rejected except that it assumes four fully baffled and preferably matched loudspeakers in a symmetrical one-in-each-corner arrangement. J.M.'s partially baffled, high-on-the-wall mounting might have prejudiced bass partly because the additional units would have radiated only the middles and highs efficiently.)

It is difficult for an individual to verify or disprove what typical listeners claim they perceive from typical program material under typical listening conditions. What one can say is that the idea seems to have fairly widespread support.

I recall that Professor Bose made a throw-away remark during his recent visit to Sydney (March, 1974, issue) along the lines: Why bother with matrix when you can simply cross-connect your rear speakers?

But such opinion notwithstanding, it would be difficult to sustain the argument that the method could provide the inherent separation that results, in a true matrix system, from the careful manipulation of signal phase, and possibly channel gain. The most that could be said was that propagation and subjective effects with a diagonal configuration might cause one to identify different sounds with different directions. The overall result would be an impression of dispersed sound.

The dispersal may not have any relationship to the original sound field; in fact, the signal may have started out as a purely 2-channel mix. But if the listener judges it to be "surround" sound, and it pleases him, one can hardly criticise him for enjoying it!

But, equally, the said listener can hardly boast that his simple installation rivals the performance of a QS, SQ or CD-4 system, or even a sum-and-difference quadraphonic simulator.

Perhaps one should hasten to acknowledge that J.M. does not make any exaggerated claims for his hook-up. He specifically says: "It's that latter part, the illusion, that I've worked upon."

To round off these columns with another, quite different audio subject, a very brief letter reads as follows:

Dear Sir,

As the number of pre-recorded cassettes increases, will there be a print-through problem with tapes that have been on the shelf too long? I haven't noticed anything in your magazine about this but comment may have escaped my notice.

With thanks for a fine magazine.

D.K. (Waverley, NSW)

In fact, I can't recall much comment anywhere on the subject of print-through in pre-recorded cassettes. It is often mentioned in connection with open-reel tape and there the advice seems to be summed up in these general terms:

1. The risk of print-through increases as the tape gets thinner; therefore do not use very thin tapes for programs that you want to store if you can use a tape with a thicker base.
2. Don't expose tapes to unnecessarily high temperatures because this will accelerate print-through. Classical traps are storing tapes in a sun-room where the ambient may be high at certain times of the day, or on a shelf above a high-powered amplifier.
3. Don't expose tapes to stray magnetic fields from transformers, motors, loudspeakers, etc.
4. Use or rewind tapes at not less than yearly intervals.

Much the same rules would seem appropriate for cassette tapes.

As for pre-recorded cassettes, my guess is that most of them would use relatively thick tape anyway, partly for strength, and partly because the program lengths dictated usually by companion disc releases, allow thick tape to be used.

On the other hand, cassettes are much more likely to be left in locked cars in direct sun and we all know how hot cars can get.

What have readers found? Is print-through with pre-recorded cassettes a real problem?

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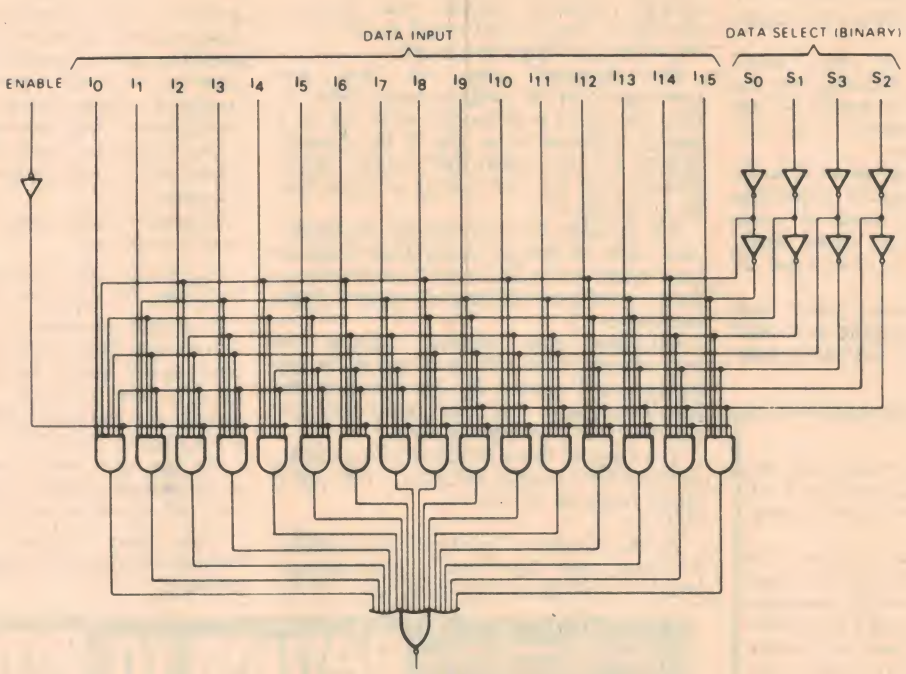

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The Serviceman

A prize winning design?

As promised in last month's notes, I am presenting a description of the EMI colour receiver, as recently demonstrated to the "Electronics Australia" staff. From a serviceman's point of view, it has several novel features, not the least of which being that it lends itself to a wide range of servicing techniques.

As also mentioned in last month's notes, the set — designated the C211 — is being submitted as an entry in the 1974 Prince Philip Prize for Australian design.

This chassis was designed by a small team of engineers and draughtsmen at EMI's Homebush laboratories over the two-year period 1972-1974. It is an all solid state PAL D colour receiver chassis designed to drive standard neck, delta gun 110 degree colour picture tubes. It is to be used in the 22 inch and 26 inch colour receivers manufactured by EMI and sold under the HMV and Healing trademarks.

Design of the chassis was begun by EMI in 1972 when two monochrome TV engineers were sent overseas to study colour television design trends in England, Germany, Italy and USA.

EMI, although a worldwide company, does not manufacture television receivers or vital components overseas. Thus, they were not pre-committed to any of the colour tubes or deflection systems then emerging, or to any other design philosophy. Rather, they were able to select what they felt were the best points of all the designs they saw.

As a result of information and personal observation during this trip a basic design specification was drawn up for the proposed receiver.

From a serviceman's point of view, the following points from this specification are of particular interest.

To be all solid state, using integrated circuits where appropriate; to use the delay line PAL type of decoder; to use an earthed mains isolated chassis; to facilitate repair by a number of different service approaches; to provide good performance in both good and fringe area signal conditions and be easy to operate; to facilitate any necessary installation adjustment by relatively unskilled personnel; to meet all relevant Australian safety and technical standards.

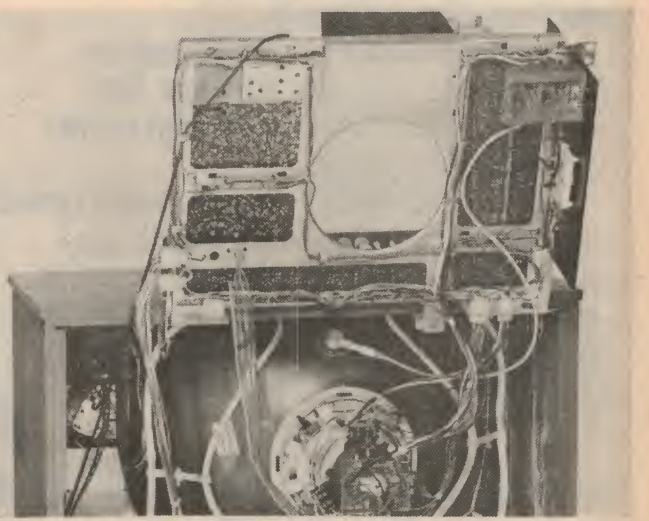
Just how well have these specifications been met? Understandably, perhaps, EMI believe they have produced "an outstanding chassis by world standards". Nevertheless, their opinion is based on the reception of the design by the retail and service organisations, technical colleges, etc, and thus carries some justification.

From a serviceman's point of view, one thing is certain. All the designs I have encountered so far indicate that ease of service — and therefore minimum cost service — is uppermost in the minds of all the local manufacturers. While each one is attacking the problem in his own way — and it remains to be seen which ones win general approval in the field — the important point is that, at long last, the servicing problem is being appreciated by the designers.

To quote EMI: "It is probable that for some years after the introduction of colour TV there will be a shortage of trained colour service technicians. Additionally, because of the distances involved in Australia and the very many retail and discount outlets the sets will be sold through, a number of quite different service methods will be used.

It is evident even before colour TV that very many television servicemen are not properly competent to service solid state monochrome receivers other than those offering easy printed board change over. Consequently, from the outset, one of the important considerations has been to facilitate rapid and easy service whilst designing for maximum reliability."

The makers have incorporated a number of design features to this end, most of them, if not conventional, at least predictable. But one of the ideas, which I will discuss in detail later, is, in my opinion, a real winner; something which, as far as I know, is unique and should prove a real blessing in the field.



Rear view of the set showing how the chassis is supported from the top of the cabinet. If necessary, it can be easily unhooked from the cabinet, unplugged from the circuitry and returned to the shop for major repairs.

But let's start at the beginning. The chassis is a "swing-up" type on which are mounted seven easily replaceable printed board modules. Over 90pc of the receiver circuit parts are contained on these boards. Each performs an easily identified specific function and plugs on or off the chassis frame, all electrical connections being made automatically without the use of any tools.

In normal use the chassis hangs vertically from specially designed hinges attached to the inside of the cabinet top, with the deflection yoke and picture tube gun protruding through a hole in the centre. The cabinet back hangs also from the slots in the same hinges and is attached by two screws to the bottom of the cabinet sides. Screws are used because of an Australian safety standard which requires the use of a tool to remove a TV receiver back.

Removal of the two screws allows the back to be removed and the chassis swung up to its vertical service position, where it automatically locks into place. The receiver may be operated for any length of time in this condition which allows ready access to both sides of the boards and all components without stooping. The picture tube screen can be viewed directly while making checks or adjustments to the circuit.

All delta gun colour receivers require a number of convergence controls to superimpose the red, green and blue colour pictures over all parts of the screen. All these controls should be easily adjustable while directly viewing the screen. In the C211 this is achieved by locating all the convergence adjustments on one board which, with the chassis swung up, is easily seen and reached whilst standing in front of the receiver.

Some receivers allow adjustment of some convergence controls from the front, but have three or four so-called static convergence adjustments accessible only at the back. In many receivers adjustment of convergence controls is strongly interrelated which makes it quite difficult to achieve satisfactory convergence in a short time, particularly by those not trained on a particular receiver type.

To make all controls accessible from the front, the designers selected a yoke having electro magnets for all functions, rather than a mixture of electro magnets and permanent magnets as is so often used. By this means even the static adjustments can be brought to the convergance panel.

The convergence controls in the C211 are all clearly labelled with the order in which they should be adjusted, and diagrams show the function each control performs. Operation of the controls is largely independent, the overall result being that persons with little previous experience can rapidly make any adjustments that might

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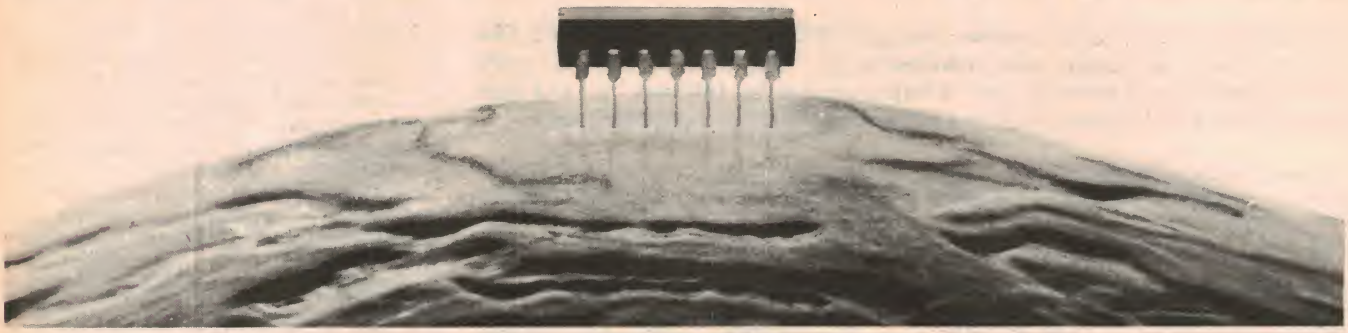

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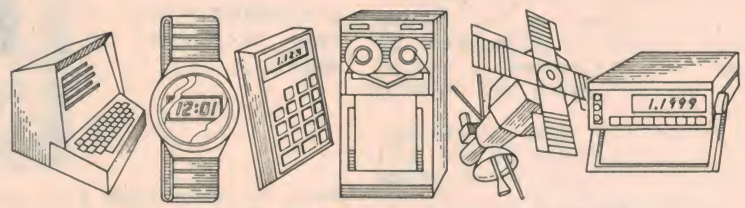

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be required when the set is installed or serviced.

A demonstration of these controls was most impressive. A control designed, for example, to converge the vertical lines at the top of the picture does just that — and nothing more. It was impossible to detect any disturbance to the vertical convergence at the bottom of the picture, over the whole range of adjustment at the top. The same applies to the horizontal controls.

The end result was also most impressive. A cross hatch pattern displayed an almost perfect white all over the screen, purity in the corners of the picture being particularly noticeable.

It has always been the custom in Australia to isolate the chassis of television receivers from the mains voltage for the safety of both the general public and the serviceman. Servicemen in Australia are not accustomed to working on "hot" chassis sets and there has always been a very strong trade reaction against them.

The C211 chassis is isolated from the mains voltage. This is usually achieved in monochrome receivers by a power transformer, but the higher power requirements of a colour set and the susceptibility of the colour tube to interference from the transformer's magnetic field means that a transformer would be very large and heavy, and almost certainly could not be mounted on a swing-up chassis. Consequently a switched-mode power supply is used.

This type of supply uses a bridge rectifier to produce DC from the mains, which feeds a high power square wave transistor oscillator working at about 22kHz. A relatively small ferrite cored transformer in the collector circuit of the oscillator transistor serves as an isolation transformer. Separate secondary windings supply the receiver.

A feedback system monitors the output voltages and controls the switching of the oscillator to regulate the output against both supply and load variations. The regulation is such that the receiver will present an unchanged picture with the input mains voltage changed between 170 and 270 volts. Additionally it has over current and short circuit protection. The circuit is relatively simple and the overall unit much smaller and lighter than an equivalent power transformer supply. The receiver uses a conventional rotary turret tuner. This is the only type presently available which will receive all 13 Australian channels and is considered to have good enough signal handling performance for local conditions. The tuner feeds its output to the IF printed board where it is amplified, gain stabilised and detected by two integrated circuits. This board also provides the sound detection and audio amplifier functions, performed by two more integrated circuits.

The colour decoding functions are all performed on one board — called the chrominance board. The decoder is of the PAL "D" type and uses one integrated circuit and a number of discrete transistors.

And this is where I feel the makers have scored a winner. The chrominance board and the rest of the circuit have been so designed that the chrominance board may be removed — in the event that it develops a fault — and the set will continue to function as a good quality monochrome set. No links or patches are required; just pull the board out, even while the set is running.

The importance of this feature, from a servicing point of view, cannot be overemphasised. As the makers point out, the remainder of the set follows the same general lines of a solid state monochrome receiver. Any serviceman reasonably familiar with solid state receivers should have little difficulty in finding his way around these sections.

But the chrominance circuits are the unfamiliar ones, where most of us are likely to bog down in the early stages. The simplest solution is to replace the board on the spot but if, for any one of several likely reasons, a replacement board is not immediately available, the customer is not deprived of his programs; only the colour.

And that, in my book, deserves full marks. Not only is it a significant technological achievement; it indicates considerable imagination on somebody's part.

As C. J. Dennis would have said, "I dips me lid."

A third small signals board contains the luminance amplifier and three video output stages. The three small signal boards just described are completely interchangeable from one set to another and are prealigned at the factory before assemblyiinto the chassis.

Vertical deflection is by a transformerless class B amplifier incorporating appropriate raster correction. This is located on another printed board, with the transistors mounted separately on a large heat sink.

Horizontal deflection and EHT generation is by a special circuit employing two silicon controlled rectifiers, as distinct from the usual very high voltage transistor. The SCR system was originally developed in concept by RCA in the USA, and is used by some German manufacturers. It is not, as far as is known, being used by any other Australian manufacturer.

It was chosen in preference to the transistor system because of its greater reliability, particularly during transient fault conditions such as picture tube flashover or EHT arcing. The system in the C211 is a later development and lower cost system than the one currently being used in German receivers and, according to the manufacturers, required a very considerable development effort.

The EHT supply of 25kV for the picture tube is achieved by tripling an 8.3kV pulse from the horizontal output transformer in a selenium diode tripler unit. The selenium tripler was chosen for its record of reliability and has been mounted, for maximum reliability, near the bottom of the chassis away from heat.

The printed wiring boards carry a reproduction of the copper pattern on the component side to facilitate circuit tracing. All components are numbered on the board, and in the service manual, making it relatively simple to relate the circuit to the hardware.

The foregoing is a brief description of the receiver, with emphasis on those aspects which I felt would appeal to fellow servicemen. As mentioned earlier, the makers appreciate that sets in the field are likely to be handled by servicemen employing a wide range of servicing techniques. The makers suggest three broad approaches, at least one of which should suit most situations.

(1) The fault may be quickly traced to a particular board which can be easily removed and replaced with a spare carried by the serviceman.

(a) The faulty board can then be sent back to EMI for repair under EMI's standardised cost board change-over service, or

(b) Service organisations may repair the boards at their base station and effectively have their own change-over service. This is possible because the boards are of conventional open construction.

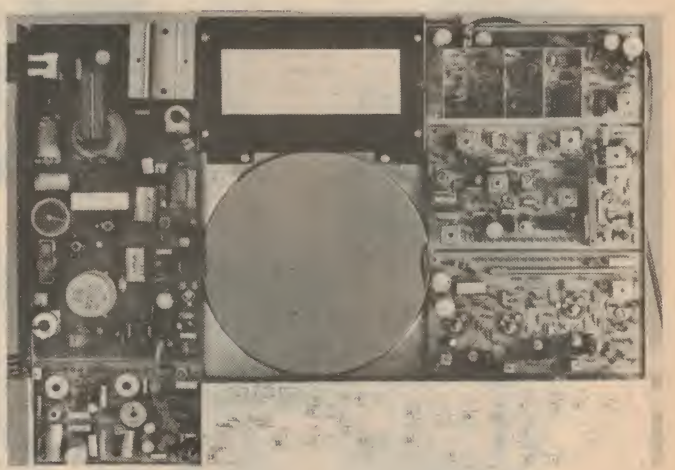
(2) Because of the easy access to the chassis, the conventional open construction of the boards, and the mounting of all integrated circuits in sockets, the receiver may be serviced in the home by a more skilled service technician who simply replaces the faulty component.

(3) In very difficult cases where the fault cannot be located in the home or the correct part is not available, all chassis connections can be unplugged, the chassis swung down to a horizontal position and simply removed from the cabinet and picture tube. Thus the chassis itself can be taken back to base for repair leaving the less easily moved cabinet in the home.

As an additional servicing aid a service switch is provided at one end of the convergence panel. This has a normal position and three special test positions which facilitate grey scale tracking, convergence or purity adjustments.

In summary: A set which (1) is capable of top quality performance; (2) has been very carefully designed to avoid the weak points of other designs and achieve the highest order of reliability; and (3) has been designed with a lot of thought and imagination to reduce servicing to its simplest terms when faults do occur.

Personally, I hope they win their prize.



The complete chassis, swung up into the servicing position, and as seen from the front of the set. The large board on the left is the horizontal deflection board, below it the vertical board, top centre the power supply. Top right the IF and audio board, below it the chrominance board, and at the bottom the convergence control panel.

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Circuit & Design Ideas

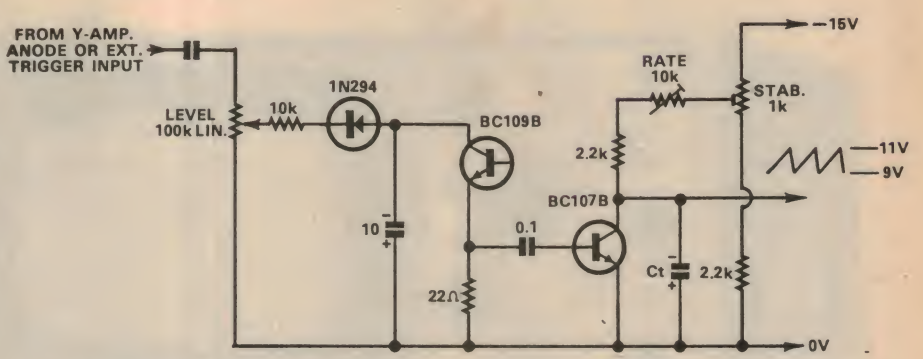
Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Timebase circuit

Advantages of this simple timebase circuit include fast flyback time due to the negative resistance operation of the transistors in the breakdown region, option of slower sweep rates by increasing CT at will, and pin-point stability adjustment found only in costly instruments. Old oscilloscopes which have only a synchronized free-running timebase can be easily modified using this cheap circuit.

The right part of the circuit consists of the timing capacitor and rate charging resistor and when the breakdown voltage of the reverse-biased BC107B (about 9 to 11 volts) is reached, the capacitor is quickly discharged. When the voltage falls by about two volts, the transistor assumes its high resistance state and the capacitor charges up again, so that in this free-running mode, a two-volt sawtooth wave is available, the frequency being controlled by the rate control.



When the 1k stability control is moved downwards, the circuit gives no output and it can be triggered by synchronizing or trigger pulses obtained from the left part of the circuit. In the figure, the Y output is used via a level control to generate pulses using a similarly reverse-biased BC109B and the 22 ohm resistor. These pulses can trigger the breakdown of the BC107B into conduction and initiate the sawtooth.

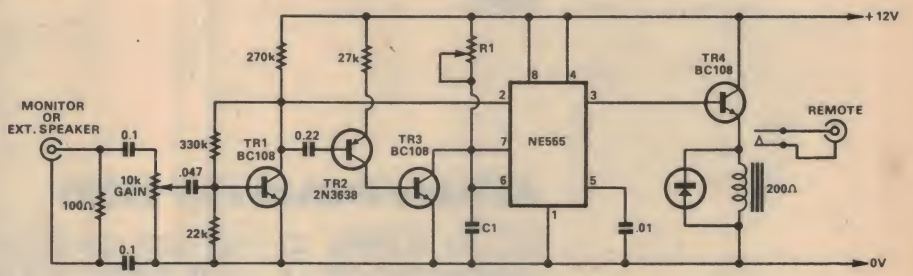
(By K. Padmanabhan, in "Wireless World".)

Long delay VOX for recorder

This long delay VOX was developed for the use of a blind person when making tape recordings. A unit was required that would trigger a tape recorder without dropping out between words, as is usually the case when VOX is used with a transmitter. Some conventional circuits were tried but the capacitor values became prohibitively large to provide the requisite time delay.

The final circuit consists of a Signetics 555 timer IC fed from a squaring circuit from the "monitor" output of the tape recorder. The output relay switches the recorder via its "remote" socket. The relay is used to switch the motor, leaving the amplifier on to operate the VOX.

The circuit derives its time constant from R1C1. The delay can be varied from about half a second to many minutes by changing these values — the larger the values, the longer the delay. R1 may be made variable, thus providing adjustment of the delay



time. R1 should not be made greater than about 20M.

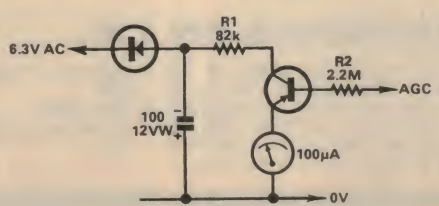
A negative-going pulse on pin 2 will start capacitor C1 charging through R1 towards the supply voltage. Immediately pin 2 is triggered the output goes high, triggering the relay through TR4. When the voltage across the timing capacitor reaches two thirds of the supply voltage, the output voltage goes low as the capacitor is discharged.

Audio fed into TR1 is converted to negative-going pulses which trigger the timer via pin 2. TR2 and TR3 reset the timing capacitor on every pulse received. This ensures that the delay is timed from the last pulse, rather than earlier signals.

(By Mr M. Hallinan, 89 Shorter Avenue, Beverly Hills, NSW 2209.)

Simple 'S' meter

It was found necessary to repair a home-built, valved, communications receiver, which had suffered transport damage to the S-meter. The original circuit used a 1mA meter, connected in a bridge circuit, involving the screen currents of IF valves. This simplified circuit, draws a very small current from the AGC rail in the receiver to drive an emitter follower, which supplies current to an S meter. The negative voltage required to power the emitter follower is obtained by half-wave rectification of the 6.3V heater rail in the receiver. The circuit fits easily on a small piece of circuit board, which can be supported by the terminal posts on the meter.



Resistor R1 should be chosen so that with the transistor saturated the current in the meter gives full scale deflection. Resistor R2 should be chosen to give about 0.95 of full scale deflection on a very strong signal. The circuit used a 100uA meter, but with changes to R1 and R2, it could probably use a 1mA meter. As the transistor is practically in a base-open-circuit condition, a transistor with sufficient Vceomax rating should be chosen.

(By M. J. Shoobridge, in "Wireless World".)

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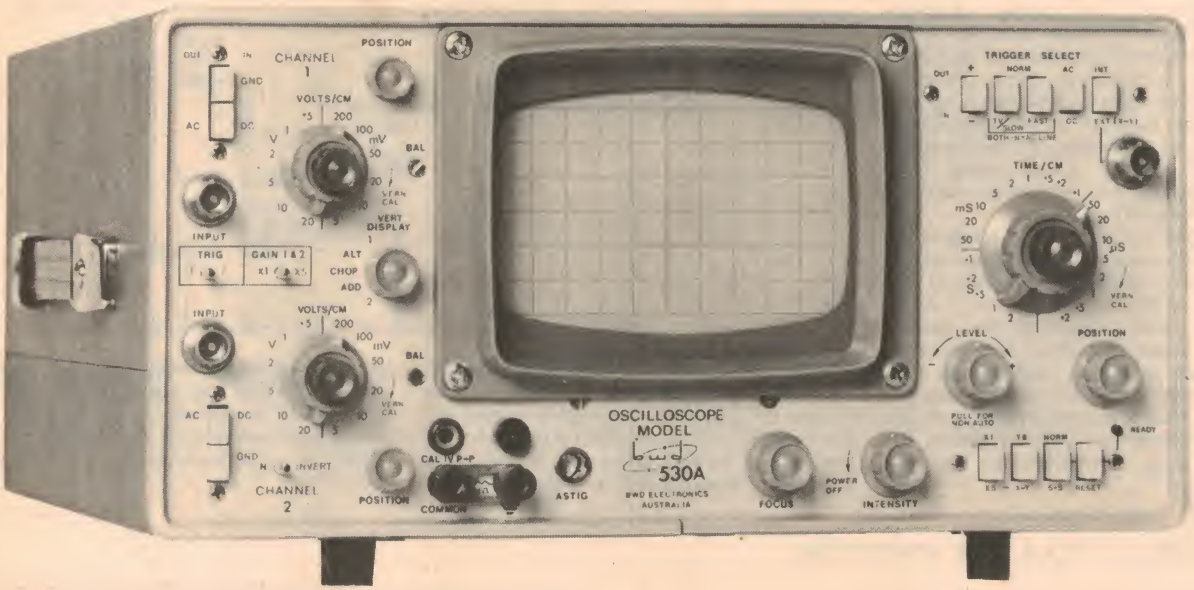

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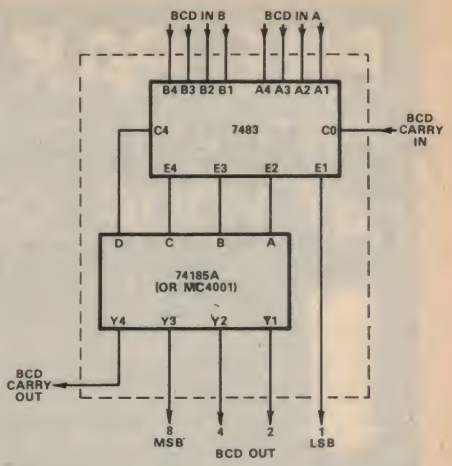
A Motorola MC4001 Binary — BCD converter may be used instead of the 74185A. In each case the unused inputs are strapped LOW, and unused outputs are left open.

Further details may be obtained from the Motorola MC4001 data sheet.

(By Alan M. Fowler, 3 Lemon Road, North Balwyn, Victoria 3104.)

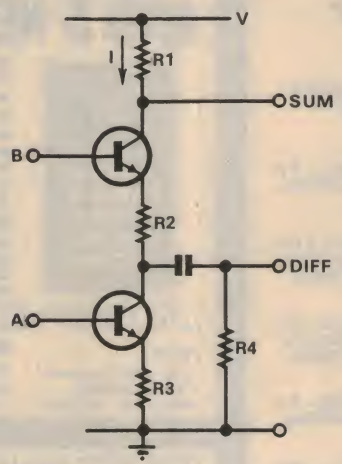


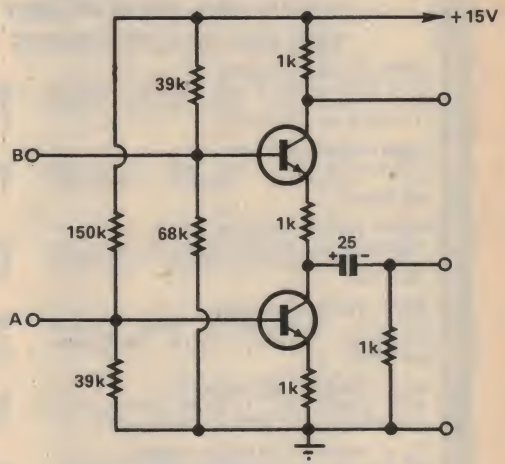
Active sum and difference circuit

The first circuit shows a simple, economical and effective method for summing and differencing two signals and is particularly effective in stereo and quadraphonic applications. Where R1 = R2 = R3 = R4 the upper output is $-\frac{1}{2}(A + B)$ and the lower output is $-\frac{1}{2}(A - B)$. Using the values shown in the second diagram, with V = 15V and I = 2mA, input signals up to 1.4V RMS may be applied.

Transistors may be BC109 or similar. Slight adjustment to R4 may be made to obtain exact null for equal antiphase inputs. By using other values for the resistors in the collector and emitter leads different weighting factors can be easily obtained. An A output is also available at the lower emitter, and a B output at the upper emitter, both fairly low impedance and with low crosstalk.

(By B J Shelley, in "Wireless World".)





Low-cost precision voltage reference

Buying a good enough voltage reference for precision comparator applications is expensive. But Donn Soderquist, a marketing applications engineer at Precision Monolithics Inc of Santa Clara, Calif, points out that an instrumentation op amp and a potentiometer are the only parts needed for a good reference — and you may already have them in the lab.

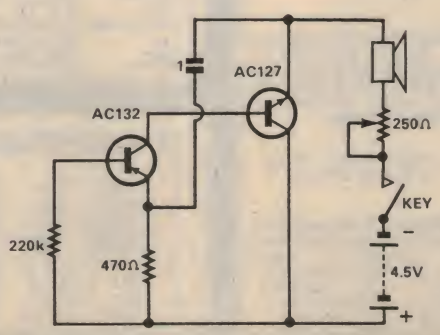
Hookup is simple. Wire the op amp as a unity-gain buffer, and place the potentiometer across the amplifier's offset-nulling terminals, with the wiper going to the positive supply voltage. The only other amplifier connections are the usual ones to the positive and negative supply voltages. Then use the potentiometer to adjust the amplifier's output to the desired voltage level.

But, cautions Soderquist, for the circuit to work well, the op amp must have low long-term drift as well as low offset drift, good power-supply rejection, and freedom from chopper and popcorn noise. The op amp should also provide high gain around a zero output voltage (to keep the circuit's output impedance low) and negligible thermal-induced drift (to achieve stable circuit performance under varying load conditions.)

(From "Electronics".)

Morse code practice oscillator

Here is a circuit for a morse code practice oscillator gleaned from "Radio Communication". The circuit is self-explanatory and some modifications may be made to accommodate other types of transistors which may be more readily available.



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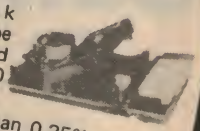

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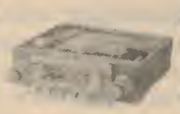

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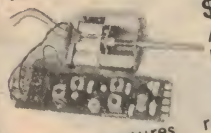

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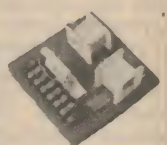

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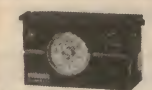

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Gas Discharge Self-Scan Panel Displays

. . . tomorrow's alternative to the CRT?

It is not inconceivable that advancing technology may one day render the cathode ray tube obsolete. Already, a great deal of research has gone into producing a flat panel display which would overcome the inherent disadvantages of the CRT, and several companies are active in this field. This article takes a look at one promising new development that has recently been made available — the Burroughs "Self-Scan" gas discharge flat panel display.

by GREG SWAIN

Starting with Ferdinand Braun's invention of an elementary form some 75 years ago, the cathode ray tube or CRT has since developed into the sophisticated reliable, mass producible device known today. Because of its versatility and relatively moderate cost, it has become the most common display device used in computer systems and a wide ranging field of other applications. However, notwithstanding the fact that it is an excellent display device capable of presenting grey-scale, colour, or monochrome images, graphics, and alphanumeric characters, the CRT is a bulky device that takes up valuable space.

There are also other disadvantages inherent in CRTs in addition to bulkiness. These include high voltage power supply requirements, fragile construction, and a limitation on the maximum practical size that can be constructed — about 25 inches in diameter. This latter restriction is due to the limitations imposed by atmospheric pressure on the wide area of glass enclosing the vacuum, and makes it impractical for the CRT to satisfy the demand for larger displays.

In an effort to reduce the bulk of such devices, early research centred on designing a flat screen CRT. Although several experimental devices were constructed, this approach presented considerable difficulties and was generally not accepted. Since then, a considerable amount of research has gone into developing a flat panel display which could perform those functions considered impossible with CRTs, and which could seriously challenge the CRT in a wide range of other applications. A viable alternative, at this stage, would appear to be the gas discharge display panel.

The first serious attempt to develop a multi-element gas discharge display was undertaken at the University of Illinois in 1964. The original plasma panel consisted of an X-Y addressable, capacitively-driven gas discharge matrix with inherent memory. However, the drawbacks of this system were multiple: driving potentials were complex and necessitated rigorous phasing relationships; it required high driving voltages at high AC frequencies which created electromagnetic interference; and the thin glass faceplates imposed a size limitation with respect to handling and fabrication.

After further research by Westinghouse Corporation, the AC plasma panel was developed into a commercial form under the name "Digivue." Announcement of this was made in 1971. This resulted in considerably lower drive potentials and frequencies as well as a practical resistor/diode multiplex drive and sustain system which drastically reduced the number of driver elements required. At the same time, the resolution achieved was comparable to that exhibited by some forms of CRT displays.

Shortly after the announcement of the original AC plasma panel, the Burroughs Corporation undertook the development of an alternative form of gas discharge display. By the end of 1967, a pulsed DC-driven dot matrix panel had been developed which appeared to have several advantages over the AC plasma panel. It possessed a memory in the form of metastable atoms having a relatively long decay time (atoms raised to an intermediate energy level from which they cannot return without interacting with and ionising other particles); it was rugged and less likely to sustain damage during fabrication and handling; and it exhibited wider operating margins.

In 1968, a random access memory panel was built in the form of a 75 x 75 dot matrix display, and with a resolution of 16 elements to the linear inch. This feasibility model — fully operational and tape addressable — required 2n drivers for an array of n x n elements, or n + m drivers for a display of n x m elements, making the cost of associated electronics considerable.

A significant breakthrough was achieved in late 1968 with the concept of scanning the display along one axis. This involved entering the data on a column-to-column basis from the first column to the last, and then resetting the display back to the first column to repeat the process. The scanning concept reduced electronic drive circuitry costs, since all vertical columns in a display could be sequentially driven by a 3-phase driving circuit and a single reset circuit, necessitating a total of four active drive elements for the columns and individual drive elements for the rows. This sequential drive was based on a cathode glow transfer phenomenon.

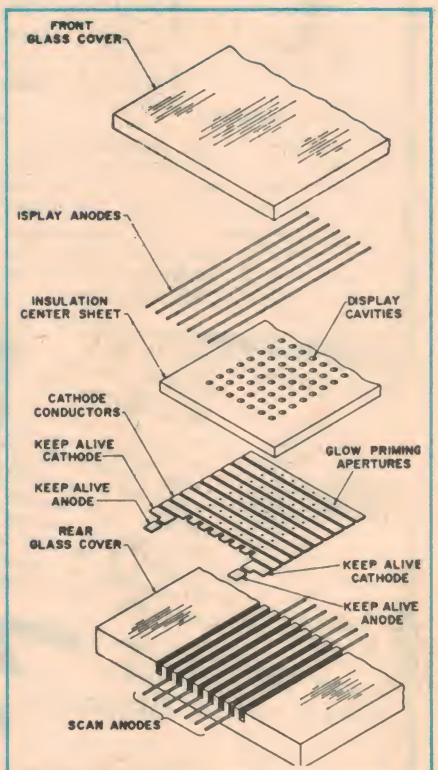
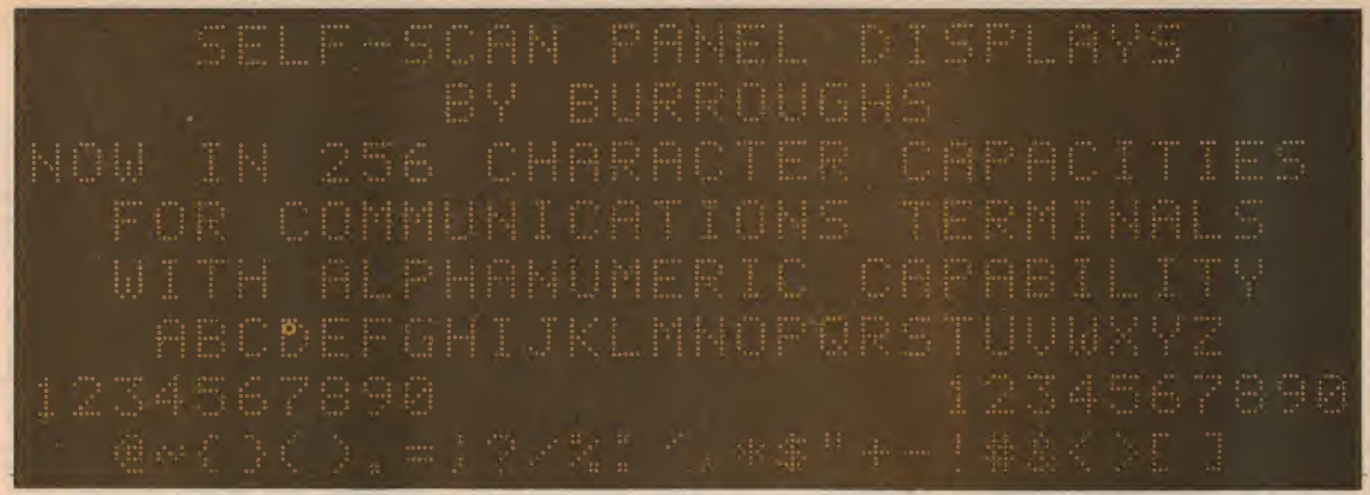


Fig 1: an exploded view of a pulsed DC gas discharge display panel showing the organisation of electrodes and display cavities.

Using the above concept a range of commercial multi-element dot matrix devices, designated by Burroughs as "Self-Scan" panel displays, were developed and announced in 1970. Since they do not possess an inherent memory, however, these devices require an external memory and must be continually refreshed. It is with the Burroughs Self-Scan range that this article is concerned.

Before launching into a generalised discussion on the characteristics and applications of gas discharge display panels, it may be as well to gain some understanding



This 256-position panel has a full 64-character repertoire, and is capable of displaying an eight-line, 32-character-per-line message.

of the basic principles of operation. As can be seen from the exploded view, the Self-Scan panel display consists of a rear glass cover, grooved to accept the rear (scan) anodes; a layer of vertical cathode strips (which includes the reset and keep alive cathodes plus the display cathodes); a centre insulating sheet drilled in a matrix format to form the display cavities; the front display anodes; and a front glass cover. These components are sandwiched together, sealed and filled with a noble gas mixture comprised mainly of neon.

The operation of the panel can best be explained by considering the unit as two separate devices. The rear portion of the panel, consisting of the grooved rear glass plate, the rear (scan) anodes, and the rear side of the cathode strip performs the scan or glow stepping routine. The cathode strips are bussed alternately to a 3-phase clock circuit, while the rear anodes are tied through appropriate load resistors to a 250V DC supply rail.

When the panel is energised, ionisation forms around the area of the keep alive cathodes, which are at ground potential, and the keep alive anodes, which are at 250V and above the firing potential. Once ionisation has formed at the keep alive cell, metastable atoms drift along the rear plate grooves to the vicinity of the reset cathode.

The panel electronics are arranged so that the rear anodes are held at +250V while the cathodes are sequentially brought to ground. When the reset cathode is grounded, a glow discharge (or ionisation) is established at each intersection of the reset cathode and the rear anodes. Metastable atoms now diffuse along the scan grooves to the rear of the first cathode. When this cathode is grounded and the reset circuit is opened, the glow transfers from the rear of the reset cathode to the primed area at the interesections of the rear anodes and the first cathode.

Metastable atoms now diffuse along the rear grooves to the second cathode strip and also through the tiny priming apertures in the first cathode strip to the diplay cell on the top of the cathode. The first cathode circuit now opens and the second cathode circuit goes to ground, transferring the glow to the intersections of the rear anodes and the second cathode. The diffusing metastable atoms will now prime the rear of the third cathode and the display cells in front of the second cathode. This process continues until all of the cathodes have been ionised sequentially.

At the last cathode in the display, the electronics senses the completed scan, resets to the first cathode strip (reset cathode), and begins the scan sequence again. The scanning rate is approximately 85Hz, so there is no perceivable flicker ie. the message on the display panel will appear continuous. The procedure detailed above would be analogous to the scanning of a CRT if the entire face of the tube was scanned in one horizontal sweep.

The panel's display section, consisting of the front glass cover, the front (display) anodes, the centre insulating sheet, and the top surface of the cathodes is addressed to write the message. This is achieved by raising the appropriate display anode to a 250V potential in synchronisation with the establishment of the scan glow on the rear side of one of the cathodes and the priming of the desired display cell. In other words, the front display anodes are addressed in synchronisation with the scanning section to cause the desired display cells to illuminate, thereby forming a message.

As the panel operates and the rear glow steps along the rear of the panel, the front anodes are addressed a full column at a time to enter the data. Fig 2 shows the panel when phase 2 is grounded and a glow is established on the rear of cathode 2. The information to be written on the panel are the letters "c" and "d", represented by the shaded cells. The scan is at column 2. Anode drivers, represented in the figure by switches, are closed at positions b and f. Therefore, the cells at the intersection of b and f and column 2 will be energised, as indicated by the solid circles.

Commercially available DC gas discharge display panels are used primarily for alphanumeric displays. In expanded form, however, they are capable of graphics presentation, and custom units have been built for this purpose. For alphanumerics, each character consists of a 5 x 7 array of display elements and is generated by a ROM character generator which drives the display anodes.

Since the gas mixture in which the discharge takes place is composed primarily of neon, the colour of the display is the typical orange-red of the neon cathode glow. By simply adding inexpensive optical filters over the faceplate, variations in colour between amber and deep red can be achieved. For applications where a red or orange display is not desirable, phosphors may be incorporated into the panel to exhibit other colours. These phosphors are photoluminescently excited by the ultraviolet (UV) radiation present in the gas discharge, and usually require an op-

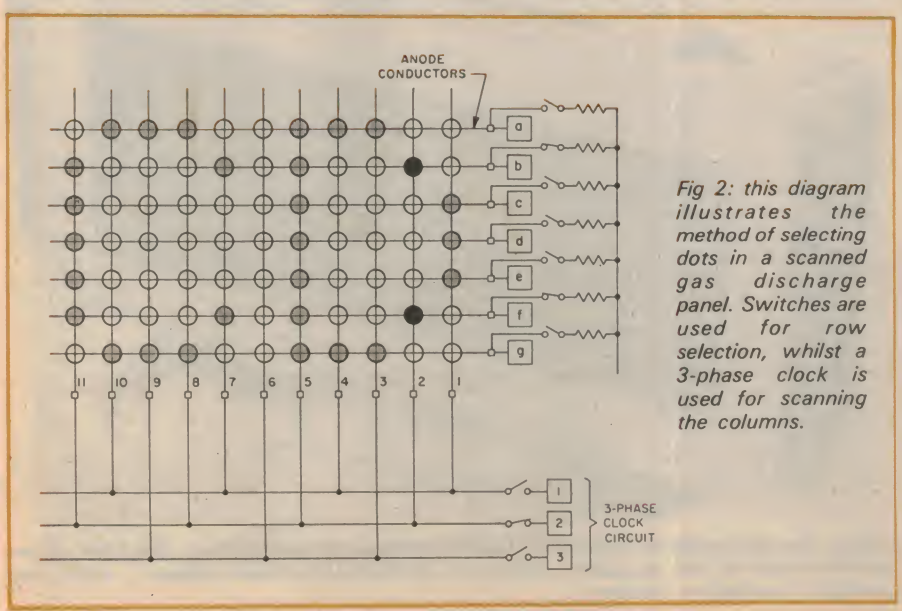


Fig 2: this diagram illustrates the method of selecting dots in a scanned gas discharge panel. Switches are used for row selection, whilst a 3-phase clock is used for scanning the columns.

GAS DISCHARGE PANEL DISPLAYS

tical filter to block the light from the neon glow. Custom 256-character panels have been built using a green phosphor, and these show little, if any deterioration with life. Experimental panels which exhibit two colours in each display cavity, selectable by choice, have also been constructed.

Under normal conditions, the DC gas discharge display operates in the bistable mode, ie. the display dots are either on or off. However, recent advances in drive and digital modulation technology have shown the feasibility of generating variable intensity displays to produce television pictures. Fully populated experimental display panels of a size equivalent to the 256-character device (discussed later in the article) have exhibited a 100:1 grey scale. This is considerably better than for most CRT systems.

Factors inherent in both the concept and construction of self-scan panel displays contribute to their superior legibility as compared to a CRT. The fixed dot matrix format ensures that the displayed characters remain geometrically consistent over the entire display area. There is no visual distortion at the edges, which can occur in all but the most costly CRT systems, resolution is uniform over the entire area, and each display dot has a precise boundary formed by the wall of each display cavity in the light-opaque cell sheet. This ensures that display characters are sharply delineated. In addition, the rigid construction of the dot matrix keeps characters in fixed positions, and there is no wavering or position change due to outside influences such as line voltage variation or ambient electromagnetic radiation.

One of the main advantages of gas discharge display panels is that they may be incorporated into equipment areas where CRT installation would be quite difficult or even impossible. Because the display panel is flat (usually less than 6cm thick), it can be placed conveniently near the viewer or near any controls the viewer might need to operate. In addition, the compact nature of these devices enables several discrete displays to be mounted in a console, or in equipment racks in areas where space is severely limited. This aspect of flexibility cannot be approached by CRTs.

Gas discharge display panels also offer a significant safety factor advantage when compared to CRTs. Since the panel contains only a few cubic centimetres of inert gas at approximately one-fifth atmospheric pressure, and since its structure consists of a rugged sandwich of densely packed internal parts, there is no risk of implosion as can occur with a CRT with its comparatively large internal vacuum. And unlike CRTs, there are no dangerously high voltages involved in driving the gas discharge panel display. The maximum voltages involved are between 250 and 300V DC and, since the panel is totally enclosed, there is no danger of making contact with these potentials.

Other advantages of gas discharge display panels over CRTs include greater life expectancy, no maintenance requirements, more rugged construction, and lower power supply requirements.

So much then for the advantages gas discharge display panels have to offer. What about their disadvantages as compared to CRTs? For a start, CRTs have a higher light output, a higher addressing rate, and are capable of higher resolution. Other main advantages of CRT devices include a higher data density capability, and the ability to be interacted with by means of a light pen.

Let's now examine some of the applications of gas discharge display panels, with emphasis on the Burroughs Self-Scan range, and take a look at what's currently available. As could be expected, these devices have a wide range of applications such as in calculators, digital clocks,

Above, the Burroughs BDS40832-200 256-position display subsystem. The panel comes complete with all the necessary electronics, including the drivers, memory, timing and character generation circuitry.

keyboard terminals, automotive and aircraft displays and instrumentation. As technology advances, it is conceivable that flat display panels could ultimately replace the CRT in black and white and colour TV sets, and several companies have already undertaken research and development programs along these lines.

Among the formats available in the Burroughs Self-Scan range are a variety of configurations capable of producing displays ranging from 16 digits to 256 digits, with or without memory, and for left-to-right or right-to-left character entry. These panels are capable of accepting high speed data entry. It should also be mentioned here that every Self-Scan panel display is supplied complete with the necessary drive electronics, character generator, and in some cases with a bezel. All can be supplied with MOS memory, and mounting kits and input/output connectors are available for each model.

Typical of the range is the MODEL SSD 1000-0041 display, a single row 16-positon panel with associated drive electronics and memory. This display has a 64-character repertoire, and has overall dimensions of 8.5 x 2.25 x 1.91in (depth). Perhaps I should have converted to metrics here! Dot spacing in the 5 x 7 matrix format is on 0.06in centres, with two column spacing between characters. These panels are also available in modified form to display 18 characters. This is accomplished by using only one column of space to separate characters. Overall character height is 0.4in.

Another typical Self-Scan panel display is the Model BDS 40832-200 256-position display subsystem. As with the above example, this panel comes with all the necessary electronics, including the drivers, memory, timing, and character generation circuitry. This format is capable of displaying an eight-line 32 character per line message, has a full 64-character repertoire, a dot spacing of 0.04in, and a viewing distance of up to 18 feet. Two space columns are used to separate characters, while three dot rows separate the lines. Overall character height is 0.3in. The same basic construction is also available in units capable of displaying 128 characters (4 rows of 32 characters) and 64 characters (2 rows of 32 characters).

One particularly interesting development in this area is the analog bar-graph display. Operating on the Self-Scan principle, this display is a flat panel containing two separate bar graphs. Each bar is composed of 200 closely spaced segments so that, at normal viewing distances, the glowing segments blend into a continuous, but precisely controlled, bar length.

Two applications that are made to order for the bar graph are matching and comparison procedures. For example, if an operator must adjust some controls until two (or more) voltages (flow rates, pressures etc) are the same, there is probably no simpler way than to adjust them until two adjacent bars are the same length. Similarly, such a device would be suitable for use in an aircraft where it would enable a pilot to find out at a glance if all engines in the aircraft were equally loaded. Other applications for the bar-graph display include automobile displays, depth indicators, and level indicators.

A number of companies are already using Self-Scan panel displays in a variety of commercial products. For example, Self-Scan panel displays are used in advanced navigation/guidance systems being developed by Delco Electronics, Division of General Motors. The system incorporates a single row high brightness 18-position alphanumeric readout in a control display unit that is dimmable. Integrated with standard cockpit instrumentation, the display exhibits aircraft position data and guidance signals computed by the system from basic sensor inputs.

In another application, Kustom Electronics Incorporated, Chanaute, Kansas, is using a 256-character generator Self-Scan panel display in their new two-way Digital Mobile Communication System. The system allows police officers direct access to law enforcement computer data bases, the information obtained being displayed on the Self-Scan panel fitted into the police vehicle. Data keyed into the mobile terminal is also displayed on the panel, and can be corrected before transmission. Although the first installations of this system are in police cars, the system has potential application wherever a two-way computer terminal is required.

Several companies are currently manufacturing electronic calculators which incorporate gas discharge display panels. The panels used here are similar in operation to the Self-Scan range, and are designated by Burroughs as the "Panaplex II" range. Among the companies involved are Computer Design of Santa Monica, California, the Keystone Division of Berkey Photo Incorporated of Paramus, New Jersey, and the Eldorado Electrodata Corporation of Concord, California. A range of Panaplex displays is also available for use in digital clocks.

At the present time, the flat gas discharge panel and the CRT cannot be presented as one superior to the other. Both have their advantages and disadvantages for particular applications, and both will continue to be in demand.

With so much time, money, and effort being expanded, it is not unreasonable to predict that the flat screen display, in one form or another, will become a serious challenge to the fragile and bulky CRT, and may eventually replace it altogether. Such is the progress of technology.

FLAT PANEL COLOUR TV DEVELOPED

Although this article has emphasised the Burroughs Corporation's Self-Scan gas discharge display panel range, the efforts of other companies such as Control Data, Westinghouse, National Cash Register, IBM, Northrop, Philips /Mullard, Hitachi, Sony, and Fujitsu should also be mentioned. Hitachi, for example, have just recently announced the development of "the world's first working prototype for a flat-profile colour TV."

The technique employed by Hitachi appears to be similar to that announced last year by Philips Research Laboratories, Eindhoven, for producing full colour displays. The approach used by Philips to get full colour displays is to use a positive-column gas discharge, as in "neon" signs, instead of the negative glow of small neon lamps, thus allowing the use of ultra-violet sensitive phosphor coatings on the inside of the matrix holes in order to obtain the required colours. Colour information is provided by using triangles of three primary colours.

In applying the technique to television, Hitachi feed the "fluorescent diode" cathodes with timing information derived from the sync signals, while video modulation is fed to the anodes.

It is also worth noting here that the Sony Corporation has also announced that it is working on both black and white and colour TV sets using gas discharge flat panel displays.

Above, a 256-position Self-Scan panel forms part of this mobile computer terminal fitted into a police patrol vehicle. The terminal allows direct access to a central police computer without having to go through the normal voice communication channels.

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PLAYMASTER 143

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Last month, we introduced our new Playmaster 143 stereo amplifier, detailed its basic design approach, and described the power supply, input wiring, headphone, and quadraphonic simulator circuitry. In this article, we address ourselves to the construction and installation of the power amplifiers and preamplifier/tone control modules, and describe the final assembly details.

by DAVID EDWARDS — PART 2

Last month we discussed the installation of almost all components except those on the printed circuit boards. The next stage is to assemble the power amplifier modules.

While the power amplifier modules have been derived from the original Playmaster 136 design, there are important differences.

The most obvious has already been mentioned, in that the new board does not carry any power supply components. Power input is by three wires; power supply earth or common, plus 21V and minus 21V. A fourth lead from the same end of the board feeds the active side of the loudspeaker circuit. The remaining connection is the shielded signal input lead which also provides the earth link back to the preamp board.

Adjacent to the plus 21V lead is a link into which a milliammeter can be inserted to measure the quiescent current of the output stage. For simplicity, we used a loop of hook-up wire with a soldered joint in the middle.

The passive components, resistors and capacitors on the wiring diagram require no special comment.

Note, however, that we have added one resistor to the amplifier, a 6.8k bridging one side of the quiescent current adjustment potentiometer. This is to protect the output transistors in the event that potentiometer wiper or element becomes open-circuit. What nappens in this circumstance is that the quiescent current control transistor, TR5, is turned off and the output transistors are turned hard on, drawing heavy current which can cause them to burn out.

While the possibility of an open circuit potentiometer is fairly remote, the 6.8k resistor provides cheap insurance. Now, in the event of an open circuit pot, the control transistor is turned on and the output transistors draw zero quiescent current. In this condition, cross-over distortion occurs but no damage eventuates and the situation can be rectified.

The transistors themselves call for special comment. Considering first the small signal transistors, there are several important points to be observed.

The original 136 board and the new board were designed for Fairchild transistors of the "glob top" variety, having their connections in a triangular configuration. The relevant type numbers have been retained to assist those who may want to use existing transistors or rebuild modules from a 136 unit.

These types of transistors are no longer available, due to changes in fabrication techniques. Instead, similar types are supplied in the "TO-92" configuration, in which the pins are in line. The original Playmaster 136 utilized Fairchild transistors, these being made available in a special offer to Electronics Australia readers. This arrangement has now lapsed and Fairchild transistors , if preferred, will have to be sought through normal supply channels.

In the meantime, other manufacturers of semiconductors have produced transistors which are a direct electrical replacement for the earlier types. Some care is required in fitting these transistors, as they do not all have the same pin configurations. Details of the device numbers and configurations are shown in the accompanying table and diagrams.

With TR1 and TR2, the transistors are fitted simply by bending the leads sufficiently to fit the triangular pattern of holes, so that they sit about one centimetre or so above the board.

The real difficulty has to do with the other three which need to make physical contact with the output transistor heat sink to provide thermal feedback.

With the glob top transistors, the requirement was met by providing three suitably positioned dimples in the underside of the heatsink, each partially filled with silicone paste. The small--signal transistors were dropped into position on the board but not soldered. The heatsink carrying the power transistors was then locked in position with the power transistor leads just emerging through the copper pattern. This done, the glob tops were pushed up into the silicone-filled dimples and the leads soldered.

The TO-9 style transistors don't lend themselves to this approach. They don't sit down snugly on the present board and the small, flat top doesn't mate naturally with a dimple. We are therefore suggesting that holes be drilled in the heatsink, which will

be a clearance fit for the TO-92 bodies, allowing the transistor to sit part way through the heatsink. A blob of silicone compound can blend the two thermally.

The mounting method has a possible bonus in that the transistors are no longer trapped under the heatsink. They could, if necessary, be extracted and replaced through the holes.

The original circuit board and heatsink was designed for use with the TO-66 style transistors, specifically the Fairchild types AY8171 and AY9171. These are no longer available, but Fairchild have suggested the use of the imported types 2N4232 and 2N3740. These pose no problems with regard to fitting, as they are also TO-66 types.

Electrically but not mechanically similar transistors are also available from other manufacturers, and these require a different mounting arrangement. This will be described immediately following the description of the mounting arrangements for the TO-66 style transistors.

The first step is to inspect the heatsinks, which should be of aluminium, not less than 16 gauge. Make sure that the two power transistors sit flat against the surface, with mounting holes aligned and with adequate clearance around the base and emitter pins. If there is any inaccuracy, lead the holes as necessary with a small round file.

In fact, we rubbed the inside surface of our own heatsinks with a large flat fine-gauge file to remove any high spots and then buffed the surface all over with steel wool.

Now check the heatsinks against the wiring board. Make sure that the bolts securing the power transistors can pass straight through, and the pins likewise. If there is any fit problem, the mounting holes in the board can be elongated as necessary.

If the small-signal transistors happen to be the older glob tops, the heatsink will need dimples or countersunk holes in the underside. If, as likely, the transistors are of the TO-92 configuration, the heatsink will need snug clearance holes instead. In fact, dimple type heatsinks can be adapted by drilling appropriate holes. They may not be concentric with the dimples, however, since the TO-92 transistors sit most naturally between the collector and emitter pins, with the base lead kinked outwards to fit the triangular pattern in the board.

With all this sorted out for each of the boards, the heatsink assemblies can be completed. Smear the underside of the power transistors with silicone compound and secure the transistors firmly to the heatsinks with ½-inch long bolts and nuts, either ⅛ Whitworth or 5BA. The transistors do not need to be insulated from the heatsink. In fact, the heatsink and mounting bolts form part of the collector circuitry.

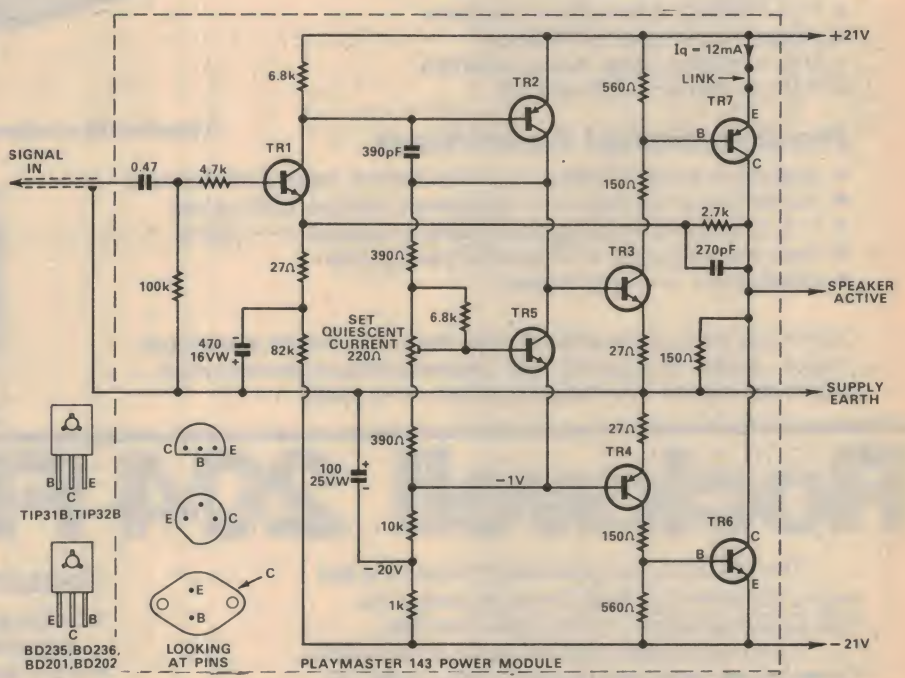
You will need four spacers per board, either 4mm or 5/32, such that when the heatsinks are mounted, the base and emitter pins of the power transistors just come through the copper pattern. We found some brass nuts of a larger size which we turned into spacers by running a ⅛in clearance drill through them. This done, the power transistors assemblies can be put aside for later installation.

On the wiring board itself, it is wise to smear the copper around the heatsink mounting holes with a thin layer of solder. If this is done, the nuts will bite into the solder when they are finally tightened and make good contact between the transistor collectors, heatsink and mounting bolts and the copper pattern on the board.

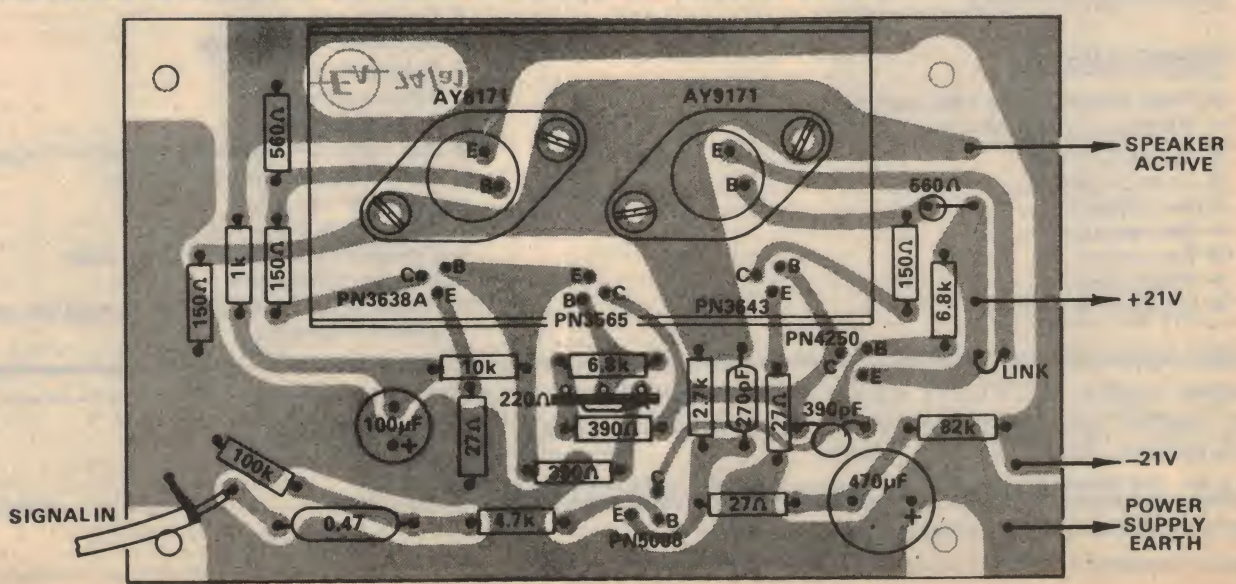
At this stage, the remaining components can be installed as per the diagram. Use an iron with a clean, slender tip and flow the solder around each component lead as quickly as possible, to avoid overheating either the pattern or the component. Make sure that you install the electrolytics with the correct polarity.

The alternative types of transistors come in an SOT-32 style case. This is a plastic package, having three pins in line, the centre one being the collector. The collector is also connected to a metal plate which forms the coupling to the heatsink. Unfortunately, different manufacturers have different configurations for the base and emitter leads.

The Philips types BD235 and BD236 must be mounted underneath the heatsink as



Above is the circuit diagram of the power module while below is the printed board shown actual size. Note the link for testing quiescent current.



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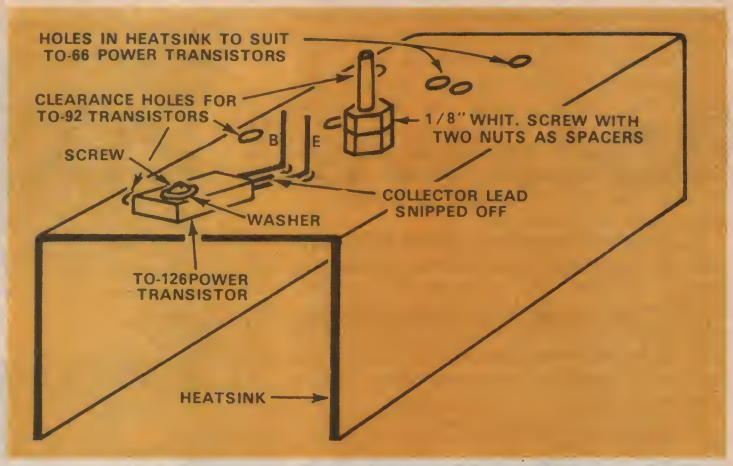
E.A.

PLAYMASTER 143 AMPLIFIER

	FAIRCHILD		TEXAS
TR1	2N5088 SE4010	BC549 BC548	BC184L BC183L
TR2	PN4250 2N4250	BC559 BC558	BC213L BC214L
TR3	PN3643 2N3643	BC549 BC548	BC184L BC183L
TR4	PN3638A 2N3638 A MPS3638A	BC559 BC558	BC213L BC214L
TR5	PN3565 2N3565	BC548 BC549	BC183L BC184L
TR6	AY8171 2N4232	BD235 BD201	TIP31B
TR7	AY9171 2N3740	BD236 BD202	TIP32B



The method of mounting the plastic BD235 and BD236 power transistors is apparent from the line drawing directly above. At left is a table listing replacements for Fairchild transistors. Pin configurations of the TO-92 style transistors may vary from brand to brand.

explained below.

The reader is referred to the accompanying sketch for full details of the method used to mount the plastic encapsulated transistors. Care should be taken that the following points are observed while fitting them.

The power transistors are fitted underneath the heatsink, and bolted to it through the holes provided to mount the TO-66 type transistors. They must be mounted with the metal part next to the heatsink, as this forms the collector connection. As a result of this, the collector lead provided can be carefully snipped off close to the body of the transistor. (The collector lead is the centre one).

To ensure that the base and emitter leads are not transposed, it is vital that the mounting hole furthest from the original centre clearance holes be used in each case to mount the plastic transistors. On the heatsink, these happen to be the holes nearest to the dimples for the driver transistors. The transistors are secured to the heatsink using suitable nuts and bolts. A small washer should be used under the head of the bolt, as shown in the diagram, and silicon grease applied to ensure good thermal contact between the transistors and heatsink.

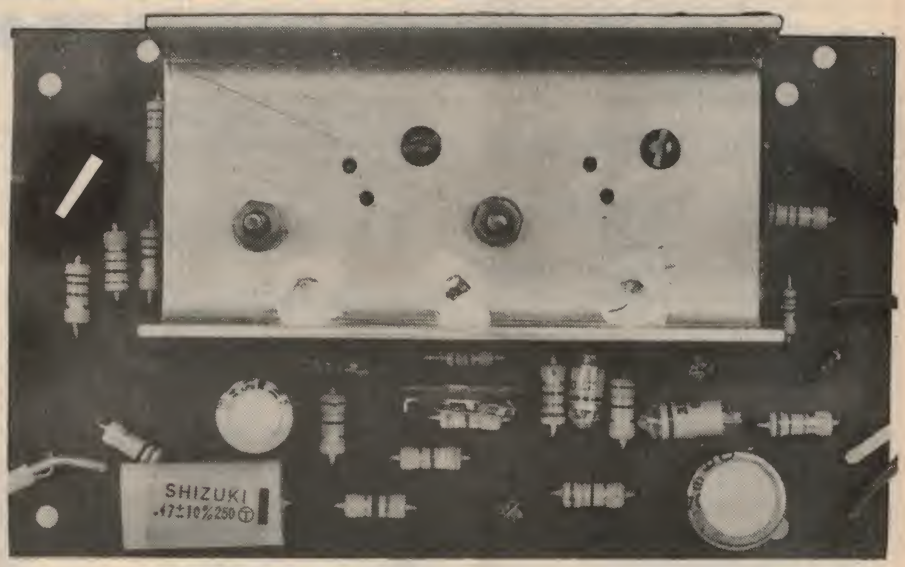
Do not use excessive force when tightening the nuts, as this may damage the transistors. Take particular care that the actual transistors are not interchanged. The heads of the bolts must be in the underside of the heatsink to ensure that the transistor leads are long enough to reach through to the copper pattern on the board.

Once the transistors have been fixed to the heatsink, their base and emitter leads may be bent as shown in the diagram. Use the holes in the heatsink as a guide, and hold the leads next to the body with a pair of small long nosed pliers to prevent them from breaking off.

The heatsink is held in position, and the collector connection made by bolts through the remaining holes. We used two nuts as spacers to position the heatsink at a suitable distance from the board. Do not forget to tin the copper pattern underneath the nuts to provide good electrical contact.

The Texas Instruments TIP31B and TIP32B are packaged in a plastic TO-126 style case, similar in appearance to the SOT-32 types. However, they differ in having the base and emitter leads transposed with respect to the Philips types.

Above is a view showing the way in which the BD235 and BD236 power transistor leads are bent. Do not allow the leads to touch the heatsink. Below is a completed power module using the BD235 and BD236 power transistors.



This means that they cannot be mounted as shown in the photograph. Instead, they must be mounted on top of the heatsink, and the leads must be bent downwards so as to pass through the holes in the heatsink. As before, the centre lead must be cut off, as the collector connection is made via the heatsink.

Do not forget to thermally bond the transistors to the heatsink using silicon grease, and do not omit the washer under the nut of the mounting bolt. This is to prevent damage to the case of the transistor. Excessive force must not be used when tightening the mounting bolts.

The heatsink is mounted in the same way as before, using ⅛in. machine screws, in conjunction with spacers made from nuts.

The fitting of the completed power modules can now be checked against the holes in the chassis. The modules are mounted on spacers, which do not have to be insulated, as appropriate clearances have been provided on the boards.

After checking the fit of the modules, remove them from the chassis. The next step is to check the power supply and only then install the modules. This procedure has less chance of damaging anything should any fault exist.

Check that the chassis and associated power supply wiring, as described last month, is correct, and that no trailing wires are resting against the chassis. If all is in order, plug the mains connector in to a

suitable receptacle and switch on. If all is in order, the indicator light should come on and voltages, plus and minus 21.5V approximately, should appear across the respective supply rails at the filter capacitors.

The first module may now be wired up to the appropriate points, as shown in the wiring diagram, and installed in position. At this stage, do not switch on.

Insert a milliammeter in the link, with plus to the supply, and set to the 250mA range. Rotate the current set potentiometer, as viewed in the chassis fully anticlockwise,and set the volume control pot at full off. Since the earthy side of the pot may not at this stage have an earth return, run a temporary link to a chassis earth.

Now watch the current meter and switch on. If the meter slams over, there is something radically wrong. Switch off instantly and check. You may have the power transistors interchanged, or one of the other transistors the wrong way round. Whatever you do, don't tempt fate by switching on again and repeating the overload condition.

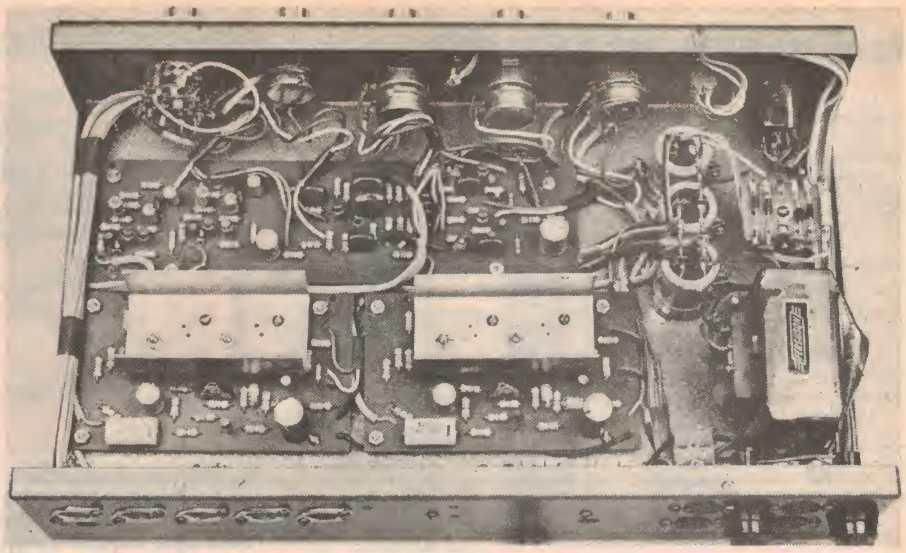
In fact, the current flow with the preset pot retarded, should be zero. If it is, reset the milliammeter to 50mA and carefully rotate the potentiometer clockwise. Bring the current up to 12mA and leave the module run for a few minutes. If all is well, switch off, remove the milliammeter and close the link.

Note that the current should be set without a loudspeaker or other load connected. When the loudspeaker is plugged in, current distribution in the output stage will change due to the small offset voltage (0.2V approx) across the loudspeaker terminals.

By now connecting a loudspeaker and feeding a signal to the volume control from any source capable of producing a reasonable signal across 50kohms, it would be possible at this stage to check the module for sound, or yet again to run instrument tests.

Once satisfied that this module is working, the second one can be connected and similarly tested. It is better to check the modules in this fashion than to wire them both in at once and switch on simultaneously. One with an inadvertent fault could be "cooking" for several minutes while the other one is being tested!

When completing the wiring to the power modules, take pains to ensure that the wiring is in accordance with the wiring diagram. In particular, ensure that the earth leads are as shown. From each



This view shows the completed chassis with all modules in position.

LIST OF COMPONENT PARTS FOR THE NEW AMPLIFIER

MAIN SECTION

1 Transformer, 240V primary, 30V C.T. secondary, 1 amp (Ferguson PF 3559 or similar)
4 EM401 silicon diodes or similar
2 47uF 100VW ceramic capacitors
1 470 ohm 1 watt resistor
3 2500uF, 35VW electrolytic, chassis mounting capacitors (A&R type RG or similar)
1 2.2k ½ watt resistor
1 Pilot light, 6V 50mA
2 1.5A quick acting fuses and holders to suit (chassis mounting types)
4 2 pin polarized speaker sockets
1 3 lug tag strip
1 6 pair tag strip
1 15 pair tag strip
1 10 ohm 5 watt resistor
2 22 ohm 5 watt resistors
1 39 ohm 5 watt resistors
2 220uF 16VW electrolytic- capacitors
2 0.47uF polyester capacitors
2 330 ohm ½ watt resistors
2 15 ohm ½ watt resistors
3 5 pin DIN sockets
2 3 pin DIN sockets
1 rubber grommet
1 mains cord and plug
1 mains cord clamp
1 3 terminal block, 240V
1 headphone socket, with double pole insolated switch
1 miniature on/off toggle switch (C&K type 7201 or similar)
1 miniature double pole double throw with centre off (C&K type 7203)
2 500K linear dual gang potentiometers
1 50K log. dual gang potentiometer
1 2.2M linear potentiometer
1 5 position 2 pole rotary switch
5 knobs to suit
1 front panel, 355 x 75mm
1 chassis and cover, 360 x 270 x 83mm

POWER MODULES (2)

2 Printed wiring boards 12.3 x 7.6cm, EA 74/a1
2 Aluminium heatsinks, 16g; 76 x 40 x 27mm overall
14 Transistors-see text

RESISTORS *(½W, 10pc)*
2 100K, 2 82K, 2 10K, 4 6.8K, 2 4.7K, 2 2.7K, 2 1K, 4 560 ohm, 4 390 ohm, 6 150
2 220 ohm preset tab pots

CAPACITORS
2 470uF 16V vertical electrolytic
2 100uF 25V vertical electrolytic
2 0.47uF 160V polyester
2 390pF polystyrene
2 270pF polystyrene

PREAMP/TONE CONTROL

1 Printed wiring board 72sa10.
2 BC109, BC549 or similar transistors.
2 BC108, BC548 or similar transistors.
4 BC108, BC548 or similar transistors.
2 Ferrite RF beads 3.5mm dia, 5mm long, type FX1115.
4 ½in or 1cm spacers with screws.

RESISTORS *(½W or ¼W, preferably 5pc)*
2 3.3M; 2 2.7M; 2 2.2M; 2 1.5M; 2 560k; 2 470k; 2 330k; 6 100k; 2 82k; 2 56k; 2 47k; 4 27k; 2 22k; 2 15k; 2 10k; 7 1k; 3 680 ohm.

CAPACITORS
1 220 UF 25VW vert electrolytic.
1 100uF 25VW vert electrolytic.
4 4.7uF 12VW vert electrolytic.
2 1.5uF 20VW tantalum electrolytic.
2 0.47uF 20VW tantalum electrolytic.
2 0.27uF 100V polyester.
4 0.1uF 100V polyester.
4 .022uF 100V polyester.
2 .0047uF 100V polystyrene.
2 .0015uF 100V polystyrene
2 680pF 100V polystyrene.
4 100pF disc ceramic.

MISCELLANEOUS

Brass spacers, brass machine screws and nuts, washers, lock washers, solder, solder lugs, coloured hookup wire, silicon grease, insulating tape, shielded cable, rubber feet.

Note: resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, providing ratings are not exceeded.

module, they are run towards each other, and then twisted together and run by the shortest direct path towards the earth rail on the filter capacitors. This takes them directly underneath the left-hand power module.

The remaining wiring is run as shown in the wiring diagram, to complete the connections to the filter capacitors and to the fuse holders. This wiring should be kept as close to the chassis as possible.

Having installed and checked the power modules, the next obvious step is to build and install the preamplifier and tone control module; this is secured to the chassis floor on four pillars in the space between the power modules and the panel controls.

The preamp and tone control unit is essentially similar to that used for the Playmaster 136, with just a couple of minor changes in circuit values.

For your guidance, we show the schematic circuit of one channel of the preamp-tone control module.

The 72sa10 board is drilled for transistors having the traditional triangular CBE lead configuration. Transistors of this type can simply be dropped straight in, with little risk of confusion. However, if you are supplied with TO92 style transistors, check the base connections carefully against the circuit diagram.

Electrically, the preamplifier provides enough gain (75 times) to ensure full drive to the main amplifier from an input of 2mV RMS, with good signal/noise ratio and adequate tolerance to peak level input signals. It provides a nominal loading of 50k ohms for a magnetic cartridge and compensation which conforms closely with the required RIAA characteristic.

Output from the compensated preamplifier goes to the "SOURCE" switch, where it is made available, along with signals from other sources: radio tuner, tape player and auxiliary inputs. Since the signal levels at this point are normally 150mV or higher, shielding is not necessary.

From the source switch, the signal passes to an emitter follower, which presents a fairly high impedance to the various signal sources, and a low source impedance for the tone control circuitry. At the same time, it provides a convenient point from which to derive signal for an external tape deck; this signal is independent of the amplifier's own volume and tone controls.

The tone control circuit is of the feedback type, favoured because of its inherently low distortion and its tolerance to higher level input signals.

The point should be made, however, that signals derived from the source switch are applied directly to a transistor base and can overload the circuitry between this and the volume control, if the level is excessive. Signals from radio tuners, tape players, &c, must be limited in some way if there is any suggestion of overload, or if you find that the amplifier is being fully driven with the volume control only fractionally on.

In constructing the preamp-tone control module, a useful first step is to check the fit of the board and chassis mounting and make any adjustments necessary by filing holes, &c. We used ½in threaded pillars, with ¼in long, ⅛in diameter countersunk screws securing them to the chassis and

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	PIV / leg	400V	600V	800V	1000V
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	PIV / leg	400V	600V	800V	1000V

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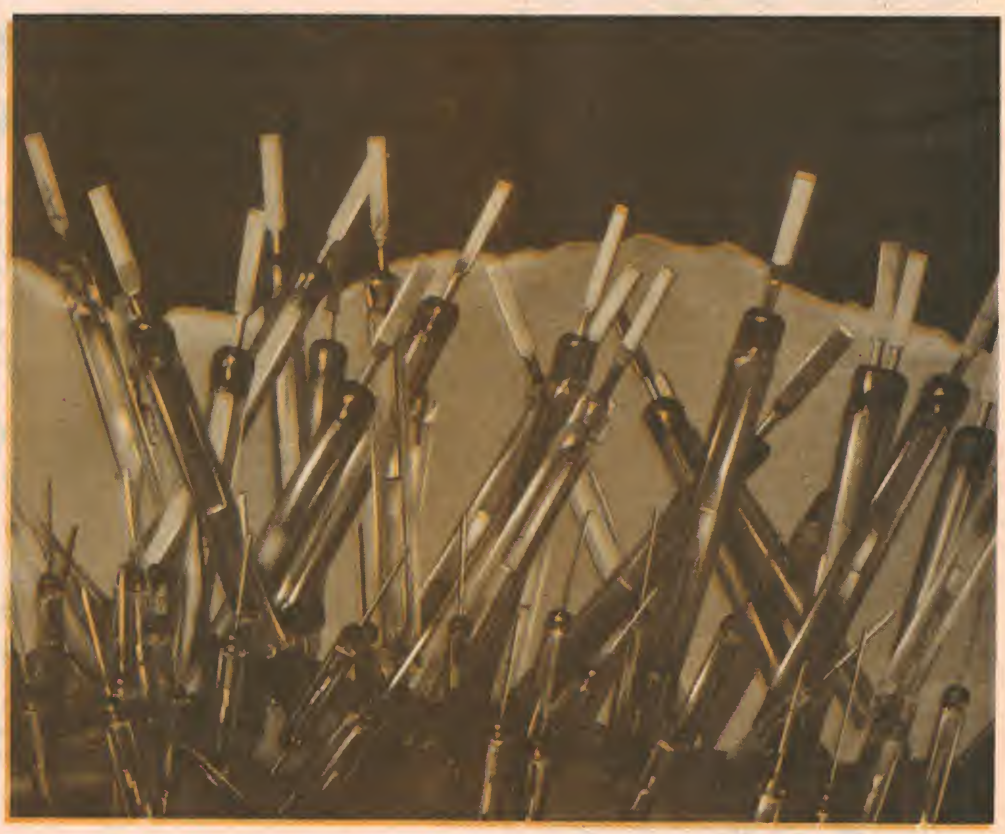

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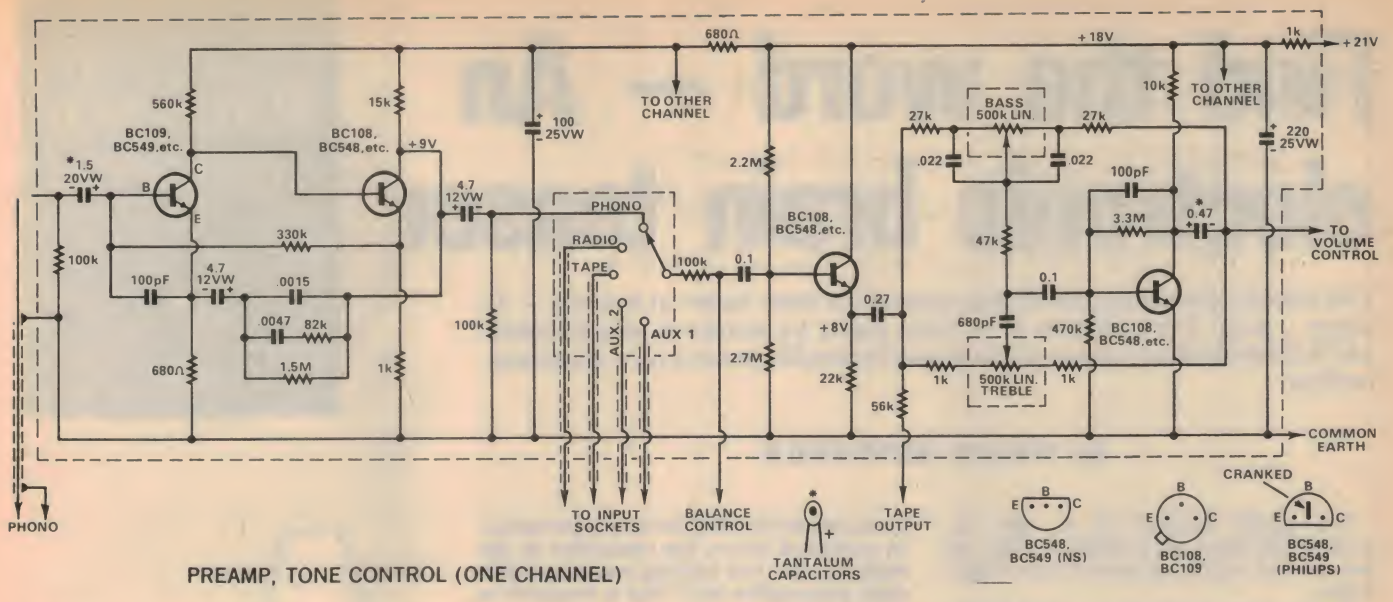
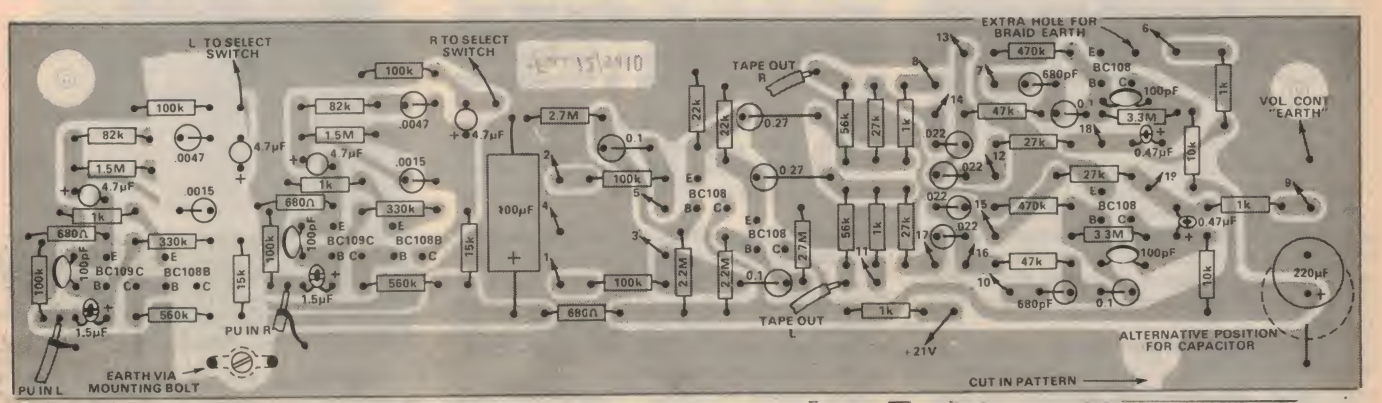


PREAMP, TONE CONTROL (ONE CHANNEL)

Schematic circuit of the phono preamp and tone control board. Take particular care if you are supplied with transistors other than those specifically shown. Check against the manufacturer's own data. Basing conventions vary from one brand to another, in some cases even for the same type number.

Below: The layout of components on the board for the phono preamp and tone control stages. We have specified the same board as for the Playmaster 136 but you may have to drill a couple of extra small holes to accommodate additional wires or slightly different components.



¼in long, ⅛in diameter roundhead screws securing the printed wiring board.

Next solder a solder lug onto the copper pattern so that it will earth the pattern next to the mounting hole nearest to the magnetic preamp inputs. This forms the main earth of the amplifier. We used a double-ended solder lug, so that it formed a bridge across the gap in the pattern which had previously been provided for when the earth was not at this point. No earth connections should be made at any of the other mounting positions.

Do not overlook the cut which is desirable in the board pattern to eliminate a possible troublesome earth loop. The exact position is shown on the component layout diagram.

For the rest, the components drop into place, as per the accompanying drawing. Polarity is important only in respect to the electrolytic capacitors, and this calls for some care. Note that we have shown an alternative position for the main decoupling capacitor, in case it happens to be larger than the one originally planned. An extra hole may be required and, for this, you will need a fine twist bit and, preferably, a small "egg-beater" hand-drill.

The most tedious job with the module has to do with the leads which must ultimately connect to the potentiometers and switches. The leads range from about 3 to 7 inches long and are unshielded, except where otherwise indicated. It is a good idea to use as many different colours as possible to facilitate lead tracing, and to use thin rather than thick hook-up to retain maximum flexibility.

The leads should be anchored to the wiring board during initial assembly and left trailing. Please yourself whether you make them all generously long, or save wire by cutting each one discretely to suit the requirement. But, whatever you do, plan for each wire to follow a gently curved path so that the board can be unbolted and lifted up for testing or service. For the same reason, leave some slack in the phono input and tape output leads, which run back to the DIN sockets.

Numbers 1-19 on the board wiring diagram relate to numbers on the main diagram and indicate where each lead goes.

These leads are best soldered at their ends after the board has been fitted in position. Do not forget to scrape off any paint underneath the spacer forming the earth connection. A good idea is to "tin" the steel beforehand, thus ensuring a good connection.

The general layout of the leads is as shown in the main diagram. Try and keep all leads as close to the chassis as possible, as this will minimise hum pickup. We found that a neat appearance could be obtained by tucking as many leads as possible underneath adjacent boards: this can be seen in the photographs.

The final step in construction is to fit the front panel, which is held in place by the switches and potentiometers. Care must be taken during this process, as a scratch on the panel can be quite unsightly, and very difficult to remove.

The amplifier is best tested by actually using it. Connect up a suitable pair of eight-ohm speakers and turn the amplifier on. Switch to stereo, and set the tone and balance controls at the mid-range position. Switch to PHONO, and turn the volume control full off. The amplifier should sound dead quiet from the listening position, and only if your head is placed right up next to the speakers should any hiss or hum be audible. When the volume control is advanced about halfway, the noise level should not increase audibly at a normal listening position.

Connect up a suitable input, and check the operation of all controls. If a suitable pair of speakers are available, the simulated quadraphonic feature may be tested. Note that true operation is not obtained unless the main speakers are connected. Using a suitable pair of headphones, check the operation of the headphone switch. All speakers must be silenced when the phones are plugged in.

Find the word — An electronic brain teaser

Elementary Electronics

This month's Elementary Electronics project is a brain teaser of the best — or worst — kind! The possibility of winning purely by chance is approximately one in three hundred thousand. It is almost impossible to solve by a systematic method.

by DAVID EDWARDS

The puzzle consists of a box approximately 200 x 240 x 65mm. On the top are marked out 25 squares of side length 40mm.

Above these squares is a small toggle switch and an indicator light. Attached to the case by a short lead is a plastic covered piece of metal. Each of the squares is labelled with a letter.

The object of the game is to spell an unknown four letter word, using the plastic covered metal object which, for the sake of convenience, we will call the pointer. When the correct word is spelt, with the letters in the right order, the lamp will light. Hopefully, the player will then know the mystery word.

A "trap" has been included to make it impossible, or very nearly so, to trigger the light by sweeping over all the letters in a random pattern. One of the letters, which does not form part of the word, will interrupt the sequence and take the player back to his starting point, without him knowing.

The game can be made easier by providing a set of clues, if it is found to be too hard. The actuating word can also be changed quite readily, should it become too well known. Some letters appear in the grid twice, so that even if the word is known there may be several ways to spell it.

As our more astute readers may have guessed, the pointer is a small permanent magnet. This is used to trigger reed relays underneath the squares. Since the magnetic field must extend through the top of the box, we must use a non-magnetic material for it.

Referring to the circuit, it can be seen that the puzzle consists basically of five reed relays formed from dry reed inserts and coils. These have been labelled from 1 to 5. R1 to R5 are current limiting resistors, to extend the life of the battery.

Reed / coil combination 1 is the "trap" mechanism. It is arranged so that the coil is connected to the battery at all times. R1 is made adjustable so that the current through the coil, and hence the resulting magnetic field strength, can be altered.

R1 is set so that the associated reed is activated, and its contacts closed. This supplies power to the remainder of the circuit. When a permanent magnet whose field opposes that of the coil is brought close to the reed / coil combination, the reed contacts will open and interrupt the current flowing to the remainder of the circuit.

Once the pointer is removed from the vicinity of R / C1, the reed contacts will close again. Thus, if the pointer is passed over R / C1, the supply to the remainder of the circuit will be momentarily interrupted. As explained below, the remainder of the reeds function in a latching mode, and this short interruption is all that is required to unlatch them.

Reed / coil combinations 2 to 5 are all wired in a similar fashion to each other. The coil of each combination is not energised until the reed contacts close. R2 to R5 are selected so that, if by some means the reed contacts are closed, the resulting field from the coil is sufficient to hold them closed. This is the latching system. The trigger to operate the reed initially is the magnetic pointer.

Thus if the magnet is brought, in turn, close to reed / coil combinations 2 to 5, each one will latch and supply current to the next one. Combination 5 turns on the indicating light L1.

In operation, each reed / coil combination is placed under an appropriate square of the front panel. R / C2 is placed under the first letter of the selected word, R / C3 under the second, R / C4 under the third and R / C5 under the fourth. R / C1 is placed under one of the remaining squares.

The reader may now appreciate how difficult it is to cheat. Not only must one select the letters of the word, one must select them in the correct order. Thus random sweeping up and down or across the board has very little chance of producing the right sequence.

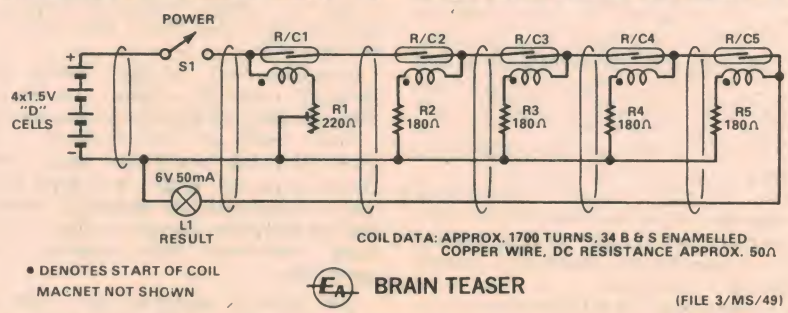
But even if it does, we have the trap circuit to contend with. If, in random sweeping, we pass over this position at any time — and this is almost impossible to avoid — any reeds we have already latched up will be immediately unlatched. The odds against picking the right sequence with random sweeping — and avoiding the trap circuit — are almost astronomical.

Having evolved the general design of the puzzle, we were faced with the task of constructing it from readily available materials and components.

The finished puzzle. This layout is only a suggestion; the number and arrangement of letters may be varied as desired.

For the reed / coil combinations, we used Plessey type ORD 225A dry reed inserts and spool type 6, part no. 801631. These should be available from the usual component suppliers at quite reasonable cost. R2, R3, R4 and R5 are all ¼ watt types, and should present no difficulties. R1 is a 220 ohm trimpot, also a ¼ watt type.

L1 is a 6V 50mA type. It would be possible to substitute a LED and associated resistor,



The circuit of the puzzle is quite simple. The reed and coil designated R / C1 is the "trap" circuit which will unlatch all the remaining reeds if it is energised during a search for the selected word. Note how its connection differs from the others.

and obtain a smaller current drain, but we felt that this was not desirable, due to possible problems involving polarities.

For power we used four 1.5V "D" cells, wired in series. With a total current drain of less than 150mA, the battery life should be quite long. S1; the on / off switch, can be any suitable type. We used a miniature toggle type.

The magnet is a small cylindrical type. It measures 19mm x 10mm (dia.) and carries the type No. FM814. It is only one of several marketed by Rola, including a series of "stick cast" magnets which, while not as well finished, would be quite suitable for this application.

Having chosen the reeds, holders and magnets, we were faced with the problem of mounting the reed / coil combinations so that the system would function correctly. The first requirement concerned the orientation of the combinations with respect to the magnet.

Experiments showed that unambiguous operation was obtained when the axis of the magnet coincided with the axis of the reed, ie, when the magnet approached the reed end on. With this arrangement, the reed would operate reliably as the magnet approached, and would not open and close during the approach as can occur with other arrangements.

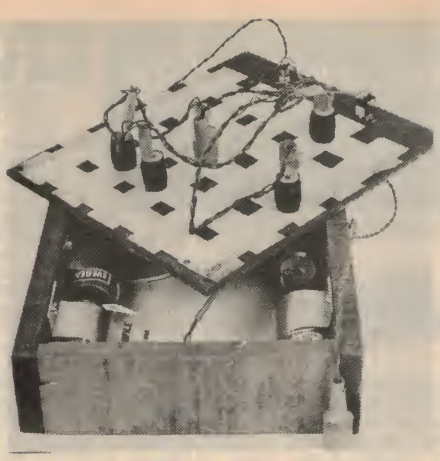
This arrangement was also convenient with regard to mounting the reed / coil combinations behind the front panel. The coil formers could simply be fixed perpendicularly underneath the panel, and the magnet used in a perpendicular manner from above.

A second requirement concerned the spacing of the combinations. Further experiments showed that if the combinations were spaced 30mm or more apart, then only one combination could be triggered at any one time. To ensure reliable operation, we used a 40mm grid.

Our next problem concerned methods of fixing the combinations underneath the top panel. To make it easy to change the activating word, it was necessary to use only a semipermanent method. Our solution was to use double sided sticky tape, arranged in grid form on the underside of the panel. The reed / coil combinations are then simply stuck to the tape.

Another method would be to glue single sided sticky tape to the panel, with the sticky side up. Alternatively, adhesive vinyl could be glued to the panel. With all these methods, mark the back in some way so that the positions of the reed / coil combinations are known in relation to the squares on the front. They must be in the centre of the squares.

For the puzzle to operate correctly, it is essential to provide the right phasing between the magnetic pointer and the coils.



Rear view of the front panel showing the pattern of double sided sticky tape used to hold the coils in their selected spots.

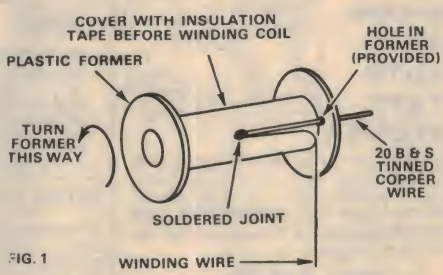


FIG. 1

How to commence the winding. The length of tinned copper wire, held by the insulating tape, takes any strain off the fine wire.

The field from the pointer must oppose the field of coil 1, but reinforce the fields of coils 2, 3, 4 and 5.

This means that the magnet must be applied the same way all the time, with its axis aligned with the axis of the reed. To ensure this, we placed the magnet inside a spare plastic shroud from a standard DIN audio connector. Any similar non-magnetic cover could be used, as long as it ensures that the magnet is always applied to the panel the same way.

We made our own case, using a small piece of masonite and some scraps of timber. Construction is not critical, and we will leave the details to the reader.

The lid of the case is painted with a glossy enamel. We used stick-on letters to mark the squares and a drawing pen to rule the lines. A covering of clear lacquer provides a scratch resistant covering. The arrangement of the letters can be seen from the photograph, but it is not necessary to

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1 Miniature on / off toggle switch.
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1 220 ohm preset trimpot.
4 180 ohm resistors, ¼ watt.
600m 34 B&S gauge enamelled copper wire.
1 Case (See text).

MISCELLANEOUS

Hookup wire, insulating tape, double sided sticky tape, solder, plastic case for magnet, tinned copper wire, scrap aluminium.

Note; resistor wattage ratings and capacitor voltage ratings are those used in our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, providing ratings are not exceeded.

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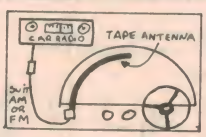

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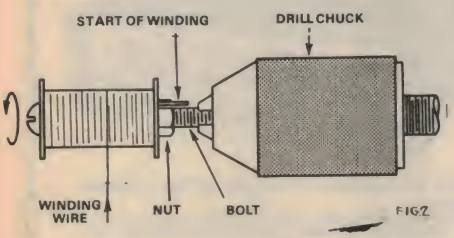
use this same arrangement.

Construction is best started by winding the coils. Each consists of approximately 1700 turns of 34B&S enamelled copper wire, wound on to the plastic spools.

To make a robust coil, it is necessary to provide a firm termination for the fragile winding wire at both the start and the finish of the winding. This is best done by soldering heavier gauge wire to the winding wire, and making a firm mechanical connection to the former.

Figure 1 shows the method we used for making the initial connection. Wrap the insulation tape firmly over the join, so that the heavy gauge wire is firmly attached to the former. This is necessary to prevent breakage of the winding wire due to movement of the lead-in wire. Clean the enamel from the area of the join before attempting to solder. A razor blade or a



The spool is wound by mounting it in the chuck of a hand drill, and the latter held in a vyce. Wind all spools the same way.

sharp knife used as a scraper makes the best tool.

The task of winding is made easier by using a hand drill. Hold the handle of the drill in a vyce, so that the chuck is horizontal. Pass a suitable bolt through through the centre of the former, and clamp it tight with a nut. Position the former so that the start of the winding is nearest to the nut. Hold the bolt in the chuck of the drill by the remaining thread.

Use one hand to turn the drill, and the other to guide the wire onto the former. Try to keep the wire in neat layers, and do not allow one section to build up more than another. It will not be necessary to count the number of turns, just wind on as many as will fit. Do not completely fill the former, as allowance has to be made for the end termination.

Regulate the winding so that the wire is at one end of the former when sufficient turns have been added. Cover the winding with insulating tape to hold it in place. Arrange the connection to the 20 gauge wire so that both ends of the coil are at the same end of the former. Firmly tape the outside again to hold the 20 gauge wire in place.

Five coils have to be wound. Ensure that they are all wound in the same direction. This will make it easier to obtain correct operation of the puzzle.

When the coils are finished, the reeds can be inserted in them. Bend one lead of each reed so that it lays back along the reed, and solder a short length of tinned copper wire to it. Insert the reed, lead end first, from the end of the former remote from the coil leads. Push it in only far enough to clear the end of the former, so that it will be as close as possible to the underside of the panel when mounted.

With four of the reed / coil combinations, connect the finish of the coil to one end of the reed. With the remaining one, connect the start of the coil to the reed. Mark this last one R / C1, and connect the 220ohm preset pot to the finish of the coil. Connect the 180 ohm resistors to the starts of the first four coils, and label them R / C2, R / C3, R / C4 and R / C5.

As shown in the circuit diagram, the wiring forms a "string" with the reed / coil combinations in order along it. This means that it is easy to reprogram the key word very easily. Only three wires connect between each combination, and only two to the batteries.

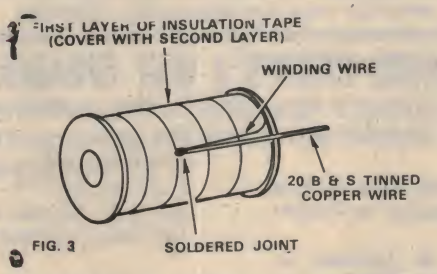
We held the batteries in place using scrap pieces of aluminium, fastened to the side of the case using self-tapping screws. The batteries are connected in series by soldering directly to their terminals.

Once all the construction has been finished, there only remains the final adjustments. Set R1 to approximately half resistance and turn on the power. At this stage, do not stick the reed / coil combinations to the panel, but leave them loose. Mark one end of the magnet in some way.

Bring the marked end of the magnet close to the end of R / C2 for a short time. Then bring it close to the end of R / C3, R / C4 and R / C5 in turn. Do not go near to R / C1. If, after approaching R / C5 the light comes on, all is well.

If the light fails to come on, repeat the process but use the unmarked end of the magnet. This should operate the light. If the light still fails to come on, reduce the value of R1 and try again.

Assume that the marked end of the magnet was found to turn on the light. Once the light is turned on bring the marked end of the magnet — ie, the same end as turned on the light — close to R / C1. The light should immediately go out, and to turn it on again R / C2, R / C3, R / C4 and R / C5 will



Terminating the finished winding. The length of tinned copper wire is secured by the insulation tape and protects the fine wire from any strain.

have to be approached again in sequence.

Once satisfactory operation has been obtained, the reed / coil combinations may be stuck in suitable positions behind the front panel, and operation checked again. R1 may now be adjusted to the largest value of resistance which will still give reliable operation. This must be done by trial and error. R1 controls the sensitivity of R / C1. A large resistance value means that the magnet does not need to be brought very close to R / C1 to trip it.

The magnet can now be placed in its holder, taking care that the correct end is at the bottom so that it can trigger the reed / coil combinations.

To prevent bare leads from the coils from shorting together, we taped them up once all the adjustments had been made, and the puzzle was operating correctly.

Be sure to turn the power switch off when the puzzle is not being used, as power is being consumed all the time, even though the light may not be on.

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Reviewed by Julian Russell

The Planets — a rare bargain

HOLST — The Planets. Suite for Orchestra. Vienna Philharmonic Orchestra with the Vienna State Opera Chorus conducted by Herbert von Karajan. Decca Ace of Diamonds Stereo SDD400.

Although this performance was recorded about 12 years ago and faces stiff competition from more recent issues, it still remains an outstanding performance extremely well engineered. Karajan's reading is in many ways unique. For instance in the opening item, Mars, the Bringer of War — Holst used the planets for their astrological associations — the first theme is usually stamped out like a sinsister heavy footed march. Karajan starts it off like the gathering of war clouds and only later turns the theme into a pounding irresistible juggernaut. Although this treatment is at odds with much English thought on this very English composition, its new conception should in no way outrage this body of opinion. Another point — Karajan takes Mars a trifle faster than is usual and in doing so increases the atmosphere of terror, turmoil and urgency.

Since, as I wrote above, Holst used the planets as astrological symbols, Venus is the Bringer of Peace and not the goddess of love, though one might be excused for suspecting that the solo violinist, judged by the rapture of his contributions, thought of her as the personifications of womanly beauty. Apart from this Karajan's reading couldn't be more tranquil, despite its undercurrent of quiet joy. Most of the movement is taken pianissimo with little surges of passion avoiding monotony.

Mercury, the Winged Messenger, is another pianissimo masterpiece featuring playing of the utmost delicacy and refinement. There are bars where I thought there was a very slight difference of pitch between the celeste and the rest of the orchestra. And if because of the overwhelmingly loud passages in Mars you have to reduce the gain in your set, you might find it necessary to put it up again to get the best benefit from this fragile trifle.

It is significant that in Jupiter, the Bringer of Gaiety, perhaps the most English of this very English suite, Karajan shows no sign of a foreign accent. However there is one passage that is an exception. In the middle ¾ section for horns, Karajan speeds up the tempo in a way that will perhaps surprise British listeners. Saturn is the Bringer of Old Age and here each instrument seems to bear its burden of years with hopeless patience. This is wonderfully evocative playing. The slow march towards the middle — with beautiful velvety pizzicatos in the bass — moves towards a vision of hope but soon sinks back again into resignation.

Uranus the Magician exploits with superb panache, his whole box of tricks. I have enjoyed this piece throughout most of my adult life yet have never heard it played with such a good natured sense of mischief as you find here. The alla marcia bit in the middle has to be heard to credit its terrific sense of exhilaration. It's all really grand and the sudden reduction from fff to a barely heard ppp is splendidly engineered.

Neptune the Mystic is as cold a bit of sound as any I now. Not too fancifully it might be imagined as coming from the frigid depths of outer space. The voices enter well but with rather too solid an attack on the top G. Ideally they should enter more gradually so that the ear becomes only slowly aware of their addition to the instruments. Later they grow steadier and withdraw sufficiently remotely to fade away quite wonderfully even by much more recent examples of recording technique. At its modest price this excellent recording of an exciting performance is a rare bargain.

★ ★ ★

PROKOFIEFF — Peter and the Wolf. With Mia Farrow (narrator).

BRITTEN — Young Person's Guide to the Orchestra. Both played by the London Symphony Orchestra conducted by Andre Previn who delivers the narration in the Britten. EMI Stereo ASD2935.

In Peter and the Wolf you have a most amiable conjugal collaboration between conductor and narrator. His approach to Prokofieff's always attractive score is unashamedly romantic. The playing is faultless and the magnificent engineering faithfully records every detail of phrasing and change of timbre. Miss Farrow starts her narration a little primly, rather like a nursemaid embarking on a fairy story, but as it gets moving she enters more into the spirit of the thing. Indeed there are moments when she seems quite carried away by the little drama. Her voice, recorded a little too forwardly to my taste, has very little trace of an American accent.

Previn makes no fuss about the commentary in the Britten piece. His manner is easy and quite without condescension. After the introduction the various instruments display their viruosity without garish spotlighting. The production is outstandingly rich toned, the engineering beautifully balanced.

This coupling has always been popular consequently this new issue will have to face strong competition. Its competitors vary as much in quality as they do in price and the cheaper ones are not always inferior to the more expensive. But if you're looking for a splendid performance superbly recorded you can't go wrong with this.

MOZART — Bassoon Concerto. Gunter Piesk, bassoon. Clarinet Concerto. Karl Leister, clarinet, with the Berlin Philharmonic Orchestra conducted by Herbert von Karajan. EMI STEREO ASD2906.

The Bassoon Concerto is likely to be a stranger to many record buyers and concert audiences. Here you will hear it beautifully played with great agility, almost piccolo-like, by soloist Gunter Piesk. Astriking feature, especially in the first movement, is his rapid changes from staccato to legato without ever breaking the forward progress of the music. This concerto is not by any means a favourite of mine but I could do no less than be lost in admiration of this performance on an instrument so rarely called upon to display such friskiness (in the first movement) and such charm (in the second). It wouldn't be Mozart if you didn't have a lovely melody somewhere and here it is in the slow movement. The Finale starts in minuet form, an unusual idea for a rondo. But it works fine though Mozart, of course, used the idea again, notably in the A Major Violin Concerto and E Flat Piano Concerto (K.271).

It is here that the bassoon sounds a little too characteristically lugubrious at times and a little more spirit might have widened its appreciation. But it should still find an audience — in addition to being a must for bassoon students. Karajan's accompaniment and the engineering balance are exemplary.

If the Bassoon Concerto is little known, the Clarinet Concerto is one of the most famous ever written and a firm favourite with audiences of all kinds. This is not the first recording by Leister of the work. He made one with Kubelik and the Berlin Philharmonic some time ago and later still another with Karajan and the same band. Leister is incontravertibly a very great clarinettist, but here, in this new issue, I fear he is not at his very best. This despite the wooing quality of his tone and wonderful technique. He tends. to make it sound a trifle too smooth and characterless. But this in no way impedes the Berlin Philharmonic from presenting still another faultless accompaniment.

★ ★ ★

SIR ADRIAN CONDUCTS WAGNER. London Philharmonic Orchestra conducted by Sir Adrian Boult. EMI Stereo ASD2934.

This disc is entitled "Sir Adrian Conducts Wagner, Volume 2". I can't recall ever having received a Volume 1 and, judging by the one under review, I have missed something very good. I have never thought of Boult as a theatre conductor except for minor expeditions into that field. But there is no doubt that, so far as Wagner is concerned, he is deeply aware of all the theatrical implications in the music.

He starts his recital with the Ride of the Valkyries evoking a fine picture of hair streaming warrior maidens in their stormy mountain surroundings. (By the way, although Wagner left the most explicit directions as to how his works were to be staged, one never sees a horse in present day productions of The Ring. The nearest one gets to this effect nowadays is, here and there, a transparency projected onto a gauze frontcloth or a backcloth. Indeed it is now many years since I have even seen Brunnhilda's horse Grane in the last act of Gotterdammerung. Anyway this per-

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formance of the Ride is as fine as you're likely to hear and is another example of top EMI sound.

In the next excerpt, the Forest Murmurs from Siegfried, the sound gradually creeps into the consciousness in the ppp opening. This indicates the extremely wide dynamic range of the recording, but don't alter the gain on your set or you will do much to destroy Boult's keen sense of balance and nuance. Also, however much you deplore Wagnerian excerpts torn bleeding from their contexts, you'll have to concede this effective contrast which takes you from wild mountain storms to a sunlit grassy plain with birds singing to the slumbering Siegfried. True this excerpt suffers badly from the absence of the vocal part — not so much the bird's song as Siegfried's excited responses to it.

Dawn and Siegfried's Journey to the Rhine from Gotterdammerung come next. In this eloquent reading it is not at all difficult to close your eyes and see the magic of the growing light rising to effulgence, then Siegfried galloping off to new adventures — and his death. I would have liked to hear a little more of the bass clarinet's echo effect but otherwise the orchestral balance is great. This is one of Wagners most evocative of his many evocative scenes.

The reverse side opens with Siegfried's Funeral March, that formidable triumph of Man at his most heroic, striding proudly through Death's domain to the sound of brass. Boult finds just the right solemnity for the occasion, holding back his climax until the final moment when he releases all his forces with stunning effect. The Tannhauser Act 2 Prelude is not that usually heard in the theatre but an extended and incomparably finer one. It is a forerunner of the earlier manifestations of the composer's more mature style which starts with the Rhinegold.

I don't think the dreary Lohengrin which followed Tannhauser can be taken as a development in style. Rather it is an example of how a good steady job in Dresden debauched the composer until his participation in the 1848 rebellion got him kicked out of the country — to the benefit of the world at large. The version played here was found to be too long for theatrical purposes and Wagner very sensibly cut it. Without this cut it would have spoiled by anticipation the climax of the act which follows, just as the introduction of the Leonore No. 3 Overture played before Act 3 of Beethoven's Fidelio wreaks similar damage. It was, by the way, Mahler's idea to introduce it and not Beethoven's. The recorded version of the Prelude includes the Pope's curse, the highlight of Tannhauser's narration later in the act. Symphonically the extended Prelude is scrappy, a collection of themes rather than a homogeneous composition. And even outside the theatre it is too long for my liking.

The recital ends with the Prelude to act 3 of Tristan and Isolda, perhaps the loneliest piece of music ever written — and I have not forgotten the slow movement of Berlioz' Fantastic Symphony. While the length of the Tannhausser item didn't seem to worry Boult, the length of the Tristan excerpt somewhat strangely does. It can be only for this reason that he doesn't use the cor anglais solo as a solo but presents it with the accompaniment that Wagner adds later in the act. With, I think, an unfortunate effect. Much of the atmosphere of stark hopelessness disappears. A pity this, because the rest of this recital has so many fine features.

★ ★ ★

CHOPIN — Piano Concerto No. 2 in F Minor. Krakoviak. Claudio Arrau (pianist) and the London Philharmonic Orchestra conducted by Eliahu Inbal.

This is aristocratic masculine Chopin played without sickly boudoir sentimentality or shimmering figurations. A comparison of Arrau's style with the only other player in his class today — Rubinstein — is inevitable. For the sake of convenience only one might describe Rubinstein as a product of the Polish school and Arrau of the German. And this is perhaps most immediately apparent in Arrau's treatment of the first movement in which he ignores, except in passages which cry out for it, what has become known as the "Chopin touch." Much, but by no means all the concerto, is played with a harder edge than Rubinstein uses. Yet this sacrifices none of the poetry. I realise the danger of making such a generalisation but I am prepared to say that

Claudio Arrau, recently in Australia for a concert tour with the ABC.

Arrau stresses Chopin the innovator while Rubinstein gives you Chopin the poet. True the roles of these two great pianists are often interchangeable. They give matchless performances despite their differences. And no one else today comes within miles of either of them.

In the Larghetto Arrau treats the music with more of the recognised Chopin approach, a pearly touch not produced here for mere prettiness but as an adjunct to the deep thought that lies behind the music. Inbal's accompaniment perfectly matches the soloists mood and the playing is romantic in the most refined sense of the word. The seldom heard "Krakoviak", otherwise called the Concert Rondo in F for Piano and Orchestra, is thrown in for most generous measure. And this might have the additional appeal of being a novelty to some buyers. Here you have a wonderful example of non-showy virtuosity.

★ ★ ★

MARIA CHIARA SINGS VERDI ARIAS. — Excerpts from I Masnadieri, I Vespri Siciliani, Otello, Aida, Joan of Arc, Simon Boccanegra and The Force of Destiny. Maria Chiara (soprano) with the Orchestra of the Royal Opera House, Covent Garden conducted by Nello Santi. Decca Stereo SCL6605.

Maria Chiara is a comparative newcomer to the recording studio, and a very exciting one too. Moreover her already lovely voice, full of sensuous beauty, gives promise of even better things to come, for it is quite obvious from this impressive recital that Miss Chiara has a mind as well as a voice. This is evidenced by the changes in characterisation in the various items she sings. I have often written in this column that in a one-composer operatic recital there is always a danger of all the characters from the various operas being made to seem alike. Not so here. Every character — and there are arias from seven Verdi operas — is sharply drawn and quite distinct from the others, no small feat in a recital of the Italian school. Her moods range from the sweetest possible simplicity in Desdemona's Ave Maria to the glinting line of the Bolero from the Sicilian Vespers.

There is not sufficient space here to follow her in all her widely differing characterisations and contrasts. But, to sum them up, I can safely write that they are as varied as they are numerous. And all are performed without the slightest hint of strain. There is, however, one exception which, because of my enjoyment of the rest of the recital, I feel churlish to mention. I refer to her performance of Leonora's aria, "Madre, pietosa Vergine" from The Force of Destiny. Here Miss Chiara is troubled by an ever so slight unsteadiness in climactic phrases. The aria gives the impression of being a bit too large for her to deal with at the present stage of her development and is what prompted me to write above that still better sounds will be heard from this very, very gifted young woman.

The accompaniments are sensitively played by the Royal Covent Garden Opera Orchestra but the conductor, Nelli Santi, is one of those unobtrusive Italian conductors who are satisfied to follow their soloist as modestly as possible. However this does not impair what is, to my mind, the most enjoyable soprano recital of Italian music that I have heard for many a long day.

Variety Fare

Reviews of other recordings

Devotional Records

COUNTRY GOSPEL. Wanda Jackson. Stereo, Word WST-8614-LP (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

In his jacket notes Bill Williams of "Billboard" remarks that this album is real country music, real Gospel and Wanda Jackson at her considerable best. And with this I heartily agree. Recorded in Nashville, Tennessee, with a gently rhythmic backing of piano, bass, guitars and percussion and supporting voices, it is a happy sound.

The tracks, from the long established to Kristofferson include: I Love You, Jesus — I Saw The Light — Jesus Cares For Me — Turn Your Radio On — I'd Rather Have Jesus — All In All — I Know — Why Me, Lord — Special Kind Of Man — Farther Along — Let Go.

An imported album from Word in Waco, Texas, the surface and the sound is good. Pleasant for family listening. (W.N.W.)

★ ★ ★

TELL THE WORLD IN '73. Jimmy Owens' Come Together Singers. Stereo, Light LS-5622-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

I am not sure whether "Tell The World In '73" was a full-scale christian musical or the title of a musical concert presentation. There are no credits on the jacket yet a vocal score is apparently available.

The album certainly has the character of a musical, orientated to rock, youth, modern instruments and modern arrangements, but retaining an element of more traditional harmony.

According to the jacket notes, the Jimmy Owens' "Come Together Singers" are drawn from the outstanding groups on the US christian scene and their abilities are not in doubt. Whether you like their music is really a matter of whether or not you like Gospel with a high (not total) rock content.

The track titles: Come Together — Like A Father — He Came In Love — Hallelujah, His Blood Avails For Me— Behold The Man — Sweet Dying Lamb — My Prayer For You — If My People Will Pray — Restoration — Tell The World.

The theme in the titles is unmistakeable and overall, if you like modern christian musicals, you'll probably listen with interest to these tracks. (W.N.W.)

★ ★ ★

THE MOM AND DADS PLAY YOUR FAVOURITE HYMNS. Stereo, Crescendo (Festival) L35115.

Maybe the Mom and Dads shouldn't be popular in this day and age, with their simple sax and accordion lead and their heavily stylised rhythm backing. But, of course they're very popular, probably for their nostalgic reminder of past days when the local group played music that was simpler, less precise but perhaps closer to home. Here the Mom and Dads aren't playing old style dances or folk favourites, although the style is precisely the same as if they were. They're playing a dozen favourite hymns: Old Rugged Cross — When The Roll Is Called Up Yonder — Just A Closer Walk — Battle Hymn — Amazing Grace — What A Friend We Have In Jesus — In The Garden — It Is No Secret — An Evening Prayer — When The Saints Go Marching In — At The Foot Of The Old Rugged Cross — Beyond The Sunset.

Yes, it's stylised, dated and lacking in polished modern musicianship but despite all that, if you're prepared to turn the clock back a few decades, you'll enjoy listening to this rhythmic, old-world performance. At least listen to a couple of tracks (W.N.W.)

Instrumental, Vocal and Humour

BRANDENBURG CONCERTOS, Nos. 1, 2 and 3 — J.S. Bach. The Netherlands Chamber Orchestra, directed by Szymon Goldberg. Stereo, Philips Universo Series 6580 100.

BRANDENBURG CONCERTOS: Nos 4, 5 and 6. Details as above. 6580 101

The Universo series has maintained impressive standards musically as well as technically, and these two discs of what have become extremely popular works by Bach (a popularity perhaps initiated by the phenomenal success of the "Switched on Bach" Moog synthesiser performance of No. 3) can be recommended with only minor reservations to those wishing to add them to their collections. These reservations are more technical than musical, and relate to the balance between the soloists and the orchestra. For example, the trumpet part in No. 2 does not sound nearly brilliant enough to me. On the other hand, record companies have been criticised by some for exaggerating the importance of solo parts. It is, I suppose, largely a matter of taste. In general, these are fine performances, which gave me intense pleasure, despite the burden imposed by critical listening. (H.A.T.)

★ ★ ★

WALTZES FROM VIENNA, Vol. 2. The Vienna National Opera Orchestra, Conducted by Max Schonherr. Stereo, Astor CGS 1415.

One could not be long in doubt that here is a native Viennese orchestra, playing the music which lies close to their hearts. Eight of the best known waltzes of the Strauss family are included: Tales from the Vienna Woods — Wine, Women and Song — Artists' Life — Roses from the South — Emperor — Vienna Blood — Village Swallows — The Spheres — Vienna Bon Bons — Blue Danube. Completing the program are Badner Madln (Komzak) — Die Schonbrunner (Lanner) — Danube Waves (Ivanovici) — Over the Waves (Rosas). This long program necessitates some curtailment of the longer waltzes, and those who like all the preludes and postludes found in full scale concert performances will not find them here. This is a modern recording, and while not entirely free of distortion, will satisfy all except the hi-fi fanatic. (H.A.T.)

★ ★ ★

GOLDEN HOUR OF THE PLANETS. The London Philharmonic Orchestra, conducted by Sir Adrian Boult. Stereo, Golden Hour GH 503.

Sir Adrian Boult is a noted interpreter of Gustav Holst's "The Planets" and under his direction the London Philharmonic presents a fine performance. The sullen menace and brutal savagery of the Mars movement set the stage for the rest of the performance and the well realised mystery of the final Neptune movement makes a fitting conclusion to the preceding orchestral excellence. The 60 minutes of playing time promised by the series titles are made up by two tone poems by Sibelius: the Prelude to "The Tempest"; and the extremely popular "Finlandia". Musically, all very satisfactory, but technically the disc suffers from old age. A fair amount of distortion and extremely limited dynamic range make this disc a dubious proposition for those with high quality equipment. (H.A.T.)

★ ★ ★

GOLDEN HOUR OF CHOPIN. Iso Elinson, piano. Stereo, Golden Hour GH 510.

Side one has the music for "Les Sylphides", but not in the orchestral arrangement for ballet performance one would expect. Somebody had the bright idea of presenting the numbers from the ballet in their original piano scores. The side is completed by the beautiful "Barcarolle". Side two has three Studies from Op. 10 - No. 3 in E, No. 4 in C sharp minor and No.7 in C minor — followed by four Preludes from Op. 28 (No 3, G major; No. 4, E minor; No. 15, D flat; No. 17, A flat). This is the largest amount of Chopin I have ever seen on one disc, and the performance, if not outstanding, is certainly a pleasurable one, with none of the irritating idiosyncracies of style and exaggerated rubatos which mar many performances. The sound is fair enough for a budget recording offering such a generous program, particularly in view of the technical compromises the lengthy playing time imposes. (H.A.T.)

★ ★ ★

GREAT OPERA CHORUSES, Vol. 2. Choir of the Vienna State Opera and Orchestra of the National Opera, director Wilhelm Loibner. Astor Gold Star Series GGS 1416.

This "Gold Star" series is, I believe, one of the lowest priced labels available, and presenting as it does in this disc 14 tracks from an outstanding group of artists, it represents good value for money. The singing is first class throughout, and the selection is a very enjoyable one: Anvil Chorus (Il Trovatore, Verdi) — Prisoners' Chorus (Fidelio, Beethoven) — Cigarette Girls' and Smugglers' Choruses, and "Au

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

Secours'' Chorus (Carmen, Bizet) — Hebrews Slaves' Chorus (Nabucco, Verdi) — Soldiers' Chorus (Faust, Gounod) — Servants' Chorus (Don Pasquale, Donizetti) — Sailors' Chorus and Spinning Chorus (Flying Dutchman, Wagner) — Bridal Chorus (Lohengrin, Wagner) — Huntsmen's Chorus (Der Freischutz, Weber) — Priests' Chorus and Finale Act 11 (Magic Flute, Mozart).

The sound is good for a budget price disc, but there are a few technical oddities, with the left channel appearing to be cutting out on occasions, and a couple of unexplained breaks in continuity. (H.A.T.)

★ ★ ★

THE GREATEST MOVIE THEMES OF THE DECADE 1964-74. Quadraphonic, Project 3 (Festival) LQ-35102.

While itself a new release, this is really a sampler from the many movie theme albums released by Enoch Light during recent years. Here are the titles: Alfie — Raindrops Keep Falling — The French Connection — Everybody's Talking — Song From "MASH" — Fiddler On The Roof — "Patton" Theme— Alice's Restaurant — "Shaft" Theme — Born Free — Windmills Of Your Mind — A Hard Day's Night.

Being a sampler, the music is something of a mixed bag but, taken all round, it is likely to please those who like fairly vigorous arrangements, rather than the soft lights and sweet music approach. But, technically, the sound is very clean and Enoch Light has seen to it that the 4-channel facility has not been wasted. (W.N.W.)

★ ★ ★

POPULAR KOTO MELODIES OF JAPAN. Stereo, Astor GGS-1429.

You've been to Japan? You have slides of castles, cherry blossoms, fishing villages, Fuji, the bullet train, the Ginza. All you need is gentle, authentic Japanese music to provide a background. Well here it is — Japanese folk music, purely instrumental, played sparsely on plucked silk strings, with occasional (bamboo?) flute solos.

There are melodies associated with cherry blossoms, fishermen, castles, and a variety of traditional situations. This much I gleaned from the English jacket notes. I assume that the Japanese characters repeat the names of the titles and performers.

Travellers aside, the album may be of potential interest also to music students, or simply for listening of a different kind. Play it through quietly and you'll find the atmosphere growing on you. As a sample, try tracks 3, 4 and 5 on side 2. Technically, the quality is excellent. (W.N.W.)

TONY MOTTOLA and the Quad Guitars. Quadraphonic, Project 3 (Festival) PJL-34946Q.

Produced by Enoch Light, this album features Tony Mottola and other members of the team, along with four guest guitarists: Vinnie Bell, Al Caiola, Don Arnone, and Al Casamente.

As you would expect, they produce some very precise sound, which is never lacking in novelty and variety but which is always very easy on the ear. The twelve tracks include: Classical Gas — Sugar Blues — Over The Rainbow— Stage Fright — Moonlight in Vermont — Chicken-a-la Swing — Charade — Galloping Guitars — Raindrops Keep Falling — Guitar Boogie — All The Things You Are — Paganini's 24th Caper.

The sound is every bit as clean as we have come to expect from Project 3, and the use of 4-channel is apparent and adequate without being conscious. A pleasant companion disc to the Project 3 test and demonstration discs featured last month. (W.N.W.)

THE CANNONBALL ADDERLEY QUINTET-INSIDE STRAIGHT Fantasy Records L35088. Festival Release.

A live audience or, rather, lively audience give this swinging record a very authentic and enjoyable sound from one of the best 'cool' jazz groups around today. There are six lengthy tracks plus introduction and ending. These are the title tracks — Inside Straight — Saudade — Inner Journey — Snakin the Grass — Five of a Kind — Second Son.

The excellent sound is due to the creation of a night club in the Fantasy studio, rather than taking the recording gear to the usual performing spot. If you have any liking for the jazz idiom, give this disc a hearing. (N.J.M.)

★ ★ ★

THE GREAT GATSBY. Original soundtrack recording. Stereo, Paramount Records L 45481/2, two disc set in folding sleeve.

After all the publicity which has surrounded the release of the Paramount film, and the copious flow of stills which has flooded into magazines, few can have any doubt that "The Great Gatsby" concerns the early years of the century, with the main action occurring in the 1920's. Most of the music is authentic, and many of the tunes are still popular today; for example, Irving Berlin's "What'll I Do", Jerome Kern's "Who" and Zez Confrey's "Kitten on the Keys. "However, a good deal of music has been created by Nelson Riddle, who conducts the orchestra. I cannot guess how the younger generation will react, but during a recent house party, a group of "oldies" had a whale of a time, jigging around to these catchy tunes. The sound is good, the packaging is attractive and the price is right — $7.95 for the two discs. (H.A.T.)

★ ★ ★

BANJOS ARE BACK, JOLSON STYLE. Astor (Rediffusion) GGS 1414 stereo.

Here is a great album of banjo music by an anonymous hand. They really plunk, blare and beat out the music. And the quality is good. Go and buy it for your next party.

Tracks are: California Here I Come — Is It True What They Say About Dixie — Carolina In The Morning — Sonny Boy — Waiting For The Robert E. Lee — Swannee — Rock-A Bye Your Baby — Alabammy Bound — Mammy — When The Red Red Robin — Hello Al — Toot Toot Tootsie. (L.D.S.)

★ ★ ★

SCOTTISH COUNTRY DANCING. McBain's Country Dance Band. Rediffusion GGS 1417 Stereo. Astor Release.

I'll probably be struck down by a Haggis in full flight for saying this but all the tracks on this record had an almost boring sameness about them.

If you come from Scotland the dances may mean more to you; of course. The music has the air of a country fair about it and the quality is very good. There are eleven titles in all: Irish Rover — Frisky Jig — Black Mountain Reel — Madge Wildfire's Strathspey — New Waterloo Reel — Set Of Jigs — Silver Tassie — Trip to Bavaria — Angus McCleod — Bonnie Lass of Bon Accord — College Hornpipe. (N.J.M.)

★ ★ ★

DIZZY GILLESPIE and the Mitchell Ruff Duo in concert. Mainstream stereo L 35080. Distributed by Festival Records Pty Ltd.

For those keen on Dizzy Gillespie, he is recorded at live concert at Dartmouth College, Hanover, New Hampshire, USA with Dwike Mitchell and Willie Ruff. Mitchell plays piano while Ruff is on Bass and French Horn. Actually I prefer Mitchell and Ruff to Gillespie. Ruff has a few solo performances on Bass which really show his talent.

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Surface noise on the disc was mostly low but at times my cartridge was hard put to track some of the grooves. Unless you have a good cartridge, better give the album a miss. Five long tracks are featured: Con-Alma — Dartmouth Duet — Woodyn' You — Blues People — Bella Bella. (L.D.S.)

★ ★ ★

PARADISE ISLES. Kana Kapiolani & His Hawaiians. Astor stereo GGS 1403.

The sleeve notes for this album suggest that there is no need to apologise for liking Hawaiian music. I have always liked it. It has never occurred to me to apologise or explain. Why should I? But if you like it I can tell you that this is a very pleasant album. Lilting instrumentals, langorous guitars and all that.

Tape hiss is noticeable if you play the disc at a loud level and my sample had its share of surface crackle but only in a few places did it become obtrusive.

Twelve tracks featured: Paradise Islands — Na Pua — Pagan Love Song — For You A Lei — Warm Hawaiian Evening — Trade Winds — Sweet Leilani — Flowered Isles — Maui Girl — My Isle On Hilo Bay — Woman Of Hawaii — Hano Hano-Lei. (L.D.S.)

★ ★ ★

UP UP AND AWAY, A Dancing Party With Victor Silvester and his Orchestra. SPLP 1423 Stereo. Astor Release.

Mr 'Strict Tempo' has done it again and produced another album of modern songs set to dance rhythms. And a very pleasing sound they make too — fourteen titles in all, including: The Good Old Bad Old Days — Moonlight In Vermont — Tie a Yellow Ribbon — Stepping Out With My Baby — Jazz Me Blues — Up Up and Away — And I Love Her — Theme from 'Ironside'. The constant flow of albums such as this show the lasting interest in the dance styles we 'wrinklies' remember best! (N.J.M.)

THE GREAT PIANO HITS. Russ Conway, Piano. Astor stereo, Golden Hour series GH-555. Also Musicassette GHC-10451.

From the very first bars, it is apparent that this is going to be the kind of music to which it is so easy to relax. Russ Conway has picked out some twenty-four tunes made popular by other pianists and, without seeking to copy their style, plays them in his own easy manner against a background of gentle rhythm.

Without attempting to list all the titles, you'll find among them: Chasing Rainbows — Walk In Black Forest — Poor People Of Paris — Tiger Rag — Old Pi'anna Rag — Misty — Sleepy Shores — Chopsticks — Alley Cat, etc.

The quality is smooth and clean and will stand playing at full room volume if you want it that way. But this is the kind of music that tinkles away happily in the background for 60 minutes, while you relax or chat or read. Good value. (W.N.W.)

Hammond festival. Pepe Manuel and his Latin-American Rhythm Group. Somerset stereo 9057. From the Astor Gold Star series.

Light hearted Hammond with lively rhythm backing. Fine for party music, as background to do the housework by or just to cheer up on a rainy Saturday afternoon. In some places, Pepe's Hammond playing is a little trite but if it really gets your goat you can always skip a track. Record quality was good throughout and surface noise was negligible.

Each of the ten tracks is a medley so there are many good tunes featured, some as follows: Brazil — Chachita — Patricia — Pepito — Eso Es El Amor — Mambo Jambo — The Millionaire — Sweet And Gentle — El Cumbanchero — Tico Tico. (L.D.S.)

★ ★ ★

THE WORLD OF SCOTT JOPLIN. Max Morath on piano. Vanguard Everyman stereo SRV 310SD.

So, ragtime is in for a revival! I doubt whether many people who are enthused over the currently showing film "The Sting" which uses Scott Joplin's music know who he was or when he lived. To answer that, he was a negro composer who in 1899 started, or maybe established "ragtime" as a viable music form with the publication of "Maple Leaf Rag". Joplin died in 1917.

And I doubt whether Joplin would be enamoured with the way his music has sparked the revival. The arrangement of his "The Entertainer", which is currently in the hit parade, is inane and irritating to most people who like the original ragtime piano music. And it is for these people for whom this album was produced. Not the trendies who are now clambering on the rag wagon. Excuse that.

Max Morath plays Scott Joplin's and other tunes in straight fashion without tizzying them up. At the same time he adds two of his own rags, "One For Amelia" and "Golden Hours" which have a very similar flavour. While surface noise is at times noticeable on the record it does make a very pleasant interlude reminiscent of older more leisurely times.

Other composers featured on the album are James Scott, Arthur Marshall, and Joseph Lamb. Apart from Morath's tunes mentioned above, the tracks are as follows: Reflection Rag — Grog Legs Rag — Palm Leaf Rag — Kinklets — A Breeze From Alabama — The Ragtime Oriole — Search Light Rag — The Pippin Rag — Top Liner Rag — Broadway Rag — The Chrysanthemum — Maple Leaf Rag. (L.D.S.)

★ ★ ★

RICHARD HARRIS. The Yard Went On Forever. Stateside. World Record Club Release WRC S/5563.

Richard Harris is probably better known as an actor than a singer but in this disc he gives us eight lengthy tracks: The Yard Went on Forever — Watermark — Interim — Gayla — The Hymns from the Grand Terrace — The Hive — Lucky Me — That's the Way It Was. The recording quality and use of stereo is good but, as for the lyrics, I would rather hear an instrumental-only version! (N.J.M.)

★ ★ ★

NON-STOP HAMMOND HITS. Alan Hawkshaw, Stereo, Polydor 2486-068.

The first sound to emerge from this album is that of percussion and it remains strongly evident all the way through. Alan Hawkshaw provides melodic continuity with the usual Hammond voicing and effects, and is assisted here and there by Ray Davies on trumpet and flugel horn. For dancing, jigging or as a party background it would be quite successful but, for straight

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listening, the uninterrupted percussion is a bit much.

Quite an array of titles appear in the medley arrangements but here's just a sampling : Music, Music, Music — Sweet Gypsy Rose — Skywriter — The Sunshine Of My Life — Tie A Yellow Ribbon — Cabaret — Superstar Medley — James Last Medley.

The playing is proficient and the sound clean but the style will not appeal to everyone (W.N.W.)

★ ★ ★

TOGETHER. The New Seekers. Stereo, Polydor 2383 264.

The New Seekers have achieved neither the success nor the world-wide recognition of the old Seeker group, but they have their following, which must be substantial for them to be featured on the prestigious Polydor label. What the group lacks, to my mind, is the clarity of diction and purity of tone of a Judith Durham, but this comparison only arises because of their choice of name. Otherwise they would be judged purely on their merits, which are certainly not insubstantial. In this selection, they present 18 titles, some in medley form — too many to list in full, but here are some: Cryin' Time — I Get a Little Sentimental Over You — Brother Love's Travelling Salvation Show — Brand New Day — Come On World — Vada Via.

Whether this is folk song in the normal sense is open to discussion — the insistent percussion with its modern rhythms is not in line with my own ideas of folk singing — but the younger generation will probably find this more to their taste. The disc does not have the clarity and definition we have come to expect from Polydor. (H.A.T.)

★ ★ ★

EVERY NIGHT IS NEW YEAR'S EVE. With Guy Lombardo and His Royal Canadians. Live at the Waldorf Astoria. Decca Phase Four Stereo PFS 4283 EMI Release.

I would be giving away my age to say I remember when Guy Lombardo was as famous for his attempts on the world water speed record as he was for his orchestra. But he is still producing the same danceable sound as before, if this record is any indication. It is more of a party medley than anything else, with twenty short segments including three bursts of 'Auld Lang Syne', as well as other favourites such as: When the Saints Go Marching In — South Rampart St Parade — Enjoy Yourself — Cabaret — Mack The Knife — Maple Leaf Rag — Johnson Rag.

The sound has suffered slightly from being a location recording but it certainly captures the spirit of a big, happy New Year's eve party. (N.J.M.)

★ ★ ★

HERE'S TO LIFE. Joan Baez with supporting artists. Stereo A & M Records L 35091.

Joan Baez sings entirely in Spanish throughout the 14 tracks on this disc, and from the complete fluency of her performance it is obvious that it is a language in which she is completely at home. Unfortunately, the same cannot be said for the average Australian listener, so it is a pity their are no translations or even synopses of the lyrics. From my own reasonably good knowledge of this language, I can say that the spirit of protest is still very much present in her performances, although now that the Vietnam war is no longer an issue, she seems to be more concerned with social issues.

Musically, she sings marvellously, with the clarity of tone and professional expertise she has always exhibited, and she is assisted here by some of the very competent musicians A & M always have available in their studios. Apart from a few popular favourites, such as Guantanamera and Cucurrucucu Paloma, the titles appear to be new and little known. However, they are all Latin American in style. The sound quality is good throughout. (H.A.T.)

★ ★ ★

JOE LOSS AND HIS ORCHESTRA. Ballroom Dances For the World Championship. Columbia Stereo SOEX 10096.

I have always regarded Victor Silvester as the King of strict tempo dance music but this record from Joe Loss takes the award. But don't let that comment spoil your enjoyment of twelve modern dance tunes well played, including: Something Is Happening — Guantanamera — Tango — Hey Jude — This is the Life — Swonderful — Girl Talk — Turn Back the Time — Boom Banga-Bang. The quality is a little variable but not enough to complain about too much. (N.J.M.)

★ ★ ★

IRISH SING-ALONG, The Bill Shepherd Singers. MCA GOLD MAPS 6999 Stereo. Astor Release.

If you have only one drop of green blood in your veins you will get a great deal of pleasure from this record of a dozen songs from Ireland. The singing is superb and disciplined but nevertheless bright and cheerful. Among the titles are: When Irish Eyes Are Smiling — The Rose Of Tralee — Kerry Dance — I'll Take You Home Again Kathleen — Mother Macree — The Girl I Left Behind Me — Christmas in Killarney.

The quality is excellent and, as a further bonus, all the lyrics are on the record sleeve. In short the ideal record to set a party sing along going (N.J.M.)

ASTOR MUSICASSETTE

SOME OF MY FAVOURITE THINGS. Acker Bilk, His Clarinet & Strings. Stereo, Astor musicassette ACT-2479.

Having been treated recently to some particularly schmaltzy background music by Acker Bilk, I rather expected this tape to be a repeat performance. Some of the numbers here like "Misty" will still please those who like the sentimental clarinet but others are in more swingin' mood, and there are even a couple of vocal interludes, which may or may not please you.

All told, there are 14 titles in what is a quite generous program: Stranger On The Shore — Clair — What Are You Doing The Rest Of Your Life? — Folks Who Live On The Hill — Close To You — The Summer Knows — Raindrops — Head — Makin' Whoopee — Misty — This Guy's In Love With You — Sugar — What A Wonderful World — A Hundred Years From Today — Going Home.

Apart from a vague suggestion of wow on a couple of isolated piano chords, the quality of the cassette is quite okay. The same program is available on disc. (W.N.W.)

KITSETS* piggy

KIT'S KOLUMN

Hum. There I am in the stock room and HE comes out of the Presidential suite and sez I have to write part of his ad for him because I know more about Kitsets stock then anyone. Lesee now . . . . .

Dimmit Dammit

A Trend light dimmer is just the thing for sexy mood lighting, NOT a kit. Comes ready to install with everything, including wall-plate and architrave fitting. Switch on and adjust globes or tubes from glimmer to glare. Easy — only 2 wires to connect. Usual white colour. Knob is golden.
P & P 50c **$9.90**

Petrol Stretcher

The way petrol is going, we'll soon be offering a pedalling kit. In the meantime, the big deal is electronic ignition. Our kit is the famous Electronics Australia 12 volt capacitor discharge unit (Aug 70). You'll pay over $40 for commercial boltons and we reckon this is still the best. Gets you better fuel economy, longer plug and points life, easier starting, zippier performance. Kit comes with secondary winding of transformer pre-wound. Complete with STC diecast box. Should pay for itself in 6 months. Tell us whether your car is positive or negative earth. P & P $1. **$20.50**

Keep your iron hot,

Kit

U-BUILD STEREO AMP. HUGE 50 WATT PER CHANNEL

Hang on to your house when you build this beauty. Superb ET circuit gives genuine 50W RMS per channel with both channels driven into 8 ohms at typically less than 2% distortion. Ideal for nerve-shattering jokes on your mother-in-law. If you can whack a crystal set together, this should be a snack for you. Complete with real teak cabinet.
P & P $3.

$115

PLAYMASTER 136 AMP. A LITTLE LESS IS A LITTLE LESS

$70

Maybe our 50W giant scares you. OK — go for this. It's undoubtedly the best medium-powered amplifier kit on the market. 13 watts RMS per channel. Performs better than ready-made units at over 3 times the price. Has provision for simulated quad. Complete, including cabinet.
P & P $2.
(Less $8.25 if Fairchild transistor pack not required)

Component Specials

If these were our only lines, we'd be out of business at these low prices. Check us out then stock up. Prices go back up at end of October.

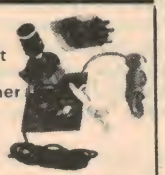
SEMI CONDUCTORS –
SN7400: **45c** SN7442M: **$1.21**
SN744N: **99c** SN7470N: **66c**
SN7473N: **55c** SN7490N: **98c**

TRANSISTORS –
BC107: 10 for **$1.80** BC108: 10 for **$1.80** BC109: 10 for **$1.80** BC177: 10 for **$2.20** BC178: 10 for **$2.20** BC179: 10 for **$2.20**

DIODES –
A15A: **70c** IN914: 10 for **$1.20** IN4004: 10 for **$1.40** A14A: **.22c**

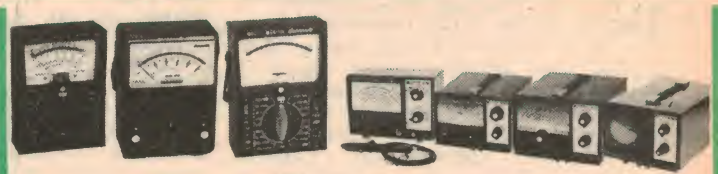
POLYESTER AND TAG TANTALUM CAPACITORS
All 10% off our 1974-75 catalogue prices. Pack/post .50c

Abracadabra Screen Wipers



12V Variwiper kit is something you can knock together in a night. A lifesaver in light rain or mist — operates wipers at selected intervals instead of continuously. Terrifies parking police. Commercial units selling in auto accessory shops for around $14. Our kit price: (P & P 50c) is only

$8·00



Multimeters & Test Equipment

University Graham Multimeters: CT500: DCx6; ACx5; Current x 4; resistance x 4. Up to 5,000V DC. 20K ohms per volt DC; 10K ohms pe volt AC. O'charge protected. P & P $1. **$19.95**

Model MVA50 Multimeter 50K ohms per volt D.C. with 5 D.C. ranges, 5 current ranges; 4 resistance ranges; 5 AC ranges. Can measure up to 1,000 volts and 10 amps. Only **$29.95** P & P $1.00.

MVA100: DCx7; ACx5: Current x 6; resistance x 4. Measures 10 amps AC & decibles. 100K ohms per volt. P & P $1.50 **$42.50**

All with test leads and batteries.

Trio Test Equipment.
VT108 FET VOM 8 ranges 0.5 to 1.5kV, 11 Meg input, ± 3% accuracy. Ohms from 0.1 to 1000 Meg. Memory feature. **$85.**

AG202A Audio Generator covers 20Hz to 200k Hz 10V rms output. Sine and square wave. External sync. **$94.**

CO1303A 75mm Scope has 20mV cm sensitivity covers DC to 1.5MHz input R & C of 1 Meg and 30pF. **$170.**

SG402 RF Generator covers 100kHz to 30MHz in 6 ranges. Output 0.1V rms. High low attenuator. Modulation at 400Hz. **$76.**

Registered Pack/Post $3.00.

KITSETS

SYDNEY: 400 Kent St. Sydney, 29 1005. **DEE WHY:** 21 Oaks Ave. Dee Why, 982 7500. **ADELAIDE:** 16A Peel St. Adelaide, 87 5505. **BRISBANE:** 293 St. Paul's Tce. Fortitude Valley, 52 8391. **MELBOURNE:** 271 Bridge Rd. Richmond (Gallery Level, Church St. entrance) 42 4651. **PERTH:** 557 Wellington St. Perth (Opp. new bus terminal), 21 3047.

If you've been saving for a rainy day, here's a sample of Kitsets shower of savings.

Reading time for this ad: about 30 minutes allowing for your double-takes at the low prices.

We take up our story as the hero reaches for chrome-plated 45 calibre soldering iron, and . . .

bank spoilers

WEENIE WONDER WHOPPER SPEAKER

Our incredible Cube 55. Cabinet only 6" x 6" x 6", yet the speaker handles 10 watts RMS! Response is 45 – 18kHz (equal to 10" twin cone speaker) voice coil has phenomenal 1½" throw. Black, red, or ivory P & P $1.50 **$14.95**

Please note that illustration shows a **pair** of system 1, and a **pair** of system 2. Yes, each kit includes grille cloth.

SPEAKER SYSTEMS-*Build in a Night!*

SYSTEM 1

Sound leaves most 8" and 10" systems for dead! Specially designed and vented 1.6 cu. ft. enclosure, houses the new Plessey CFL (Controlled fibre length) C12PX 12" twin cone, wide-range speaker covering the bass and mid-range and the crystal-clear Plessey X30 1" dome tweeter covering the highs. Frequency response: 30-20,000 Hz. Power Handling capacity: 30 watts RMS. *OUR SPEAKER ENCLOSURE COMES PRE-ASSEMBLED AND VENEERED and requires only a small amount of final-assembly and strip veneering to complete! EACH 12" SYSTEM FOR ONLY **$49.99**

ALSO AVAILABLE FULLY ASSEMBLED FOR **$70** EACH.

Pack/Freight $5.00 each.

SYSTEM 2

Plessey C12P 12" woofer, a Plessey C6MR 6" sealed back mid-range and a Plessey X30 1" dome tweeter. Smooth wide response that only a 12" three-way system can offer. Handling power is a full 30 watts RMS and the handsome 2.65 cu. ft. enclosure is exclusive to Kitsets Aust. The only one of its kind at our price! System Kit (including cabinet) (Freight 6.50) **$65**

Cabinet Kit price (Freight $5.50) **$25.00**

Low priced Valves

Not low quality – just low price. 6 of the most-used T.V. receiver valves at prices that make it worth stocking up big. They're Matsushita ("National") so you know they're good. Don't fall for cheap-jack rip-offs others offer. These are really top grade. We'll keep supplying them as long as our stocks hold out. Mix types any way you like to get the low quantity prices. Special quotes on orders over 100. Minimum order, 10 mixed valves.

TYPE	LIST PRICE	PRICE EACH FOR MIX OF	
NORMAL PRICE		10 – 50	50 – 100
1S2	$1.98	$1.20	$1.10
6AL3	$2.00	$1.20	$1.10
6BL8	$2.00	$1.20	$1.10
6MB8	$2.10	$1.20	$1.10
6CM5	$2.90	$1.90	$1.80
12AV7	$1.92	$1.20	$1.10

pack/post 50c

Kits you might have missed.

Playmaster 140 4ch amp. Has latest Motorola SQ decoder I.C. MC1312P. With teak cab. P & P: $3. **$142.**

ETI 420 4ch. amp. Has I.C. above, but 1.5w RMS per ch. (4 driven) less at 12.5. P & P: $3. **$133.**

Musicolour Mk. II. Electric rainbow! Needs no sep. amp. Hook up to your own 240V inc lamps. P & P: $2.50 **$51**

Moodcolour 4. The ultimate. 4ch with 1kW load capability per ch. Individual bandwidth adjust. P & P: $3. **$71**

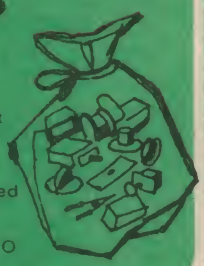
6 to 12V converter. Doubles batt. input voltage. Beaut for radio car cassette conversion P & P: $1. **$19.50**

SCR speed control: 240V. Suit brush motors to 1kW. No loss of torque on electric drills. P & P: $1. **$13.90**

Is Kitsets* the right name?

We've been tossing this one around for quite a while now. When we first started out, the name was right, but now we're expanding into some pretty sauve Hi-Fi areas, maybe the name doesn't fit. What do you think? No prizes for suggestions, but we'll see if Kit can find room for some of your comments in her next kolumn.

GRAB BAGS **$2**



Electronic lucky dip. Tail ends of stock we haven't got enough of to advertise separately. Anything goes. Switches, diodes, resistors, coils etc. Each bag guaranteed to have retail value of at least $5. P & P free. AVAILABLE ONLY ONE TO EACH ORDER OVER $10.

Our showrooms are open normal business hours as well as Saturday mornings. Come in and have a nosey round, or bring us your electronic problems – we're delighted to help anytime . . . no charge!

Use this coupon for mail order. Please don't send cash. Remit by Postal Order or crossed cheque, made payable to Kitsets (Aust) Pty Ltd. Send to P.O. Box 176 Dee Why 2099. For PMG/COD delivery, call 982 7500 (Area code 02) anytime (24 hour service) and tell us what you want. Orders are despatched within 24 hours. Please fill out form carefully and PRINT all details NEATLY. If your order comes in looking like a second-hand pakapoo ticket, we have to hang on to it until you send us a furious letter. And that doesn't do either of us any good.

SEND TO: . . . . . .

ADDRESS: . . . . . .

. . . . . P'code . . . . . Phone . . . . . .

A	B	C	D	E
HOW MANY	NAME OF GOODS AND CODE NUMBER IF GIVEN	PRICE EACH	P & P EACH	SUB TOTAL
			If you want your order sent registered (advisable) add 75c	
	:ITEM TOTAL: add column A.		REMITTANCE TOTAL: Add Column E	

Product reviews & releases

University FET meter, valve tester

Recent additions to the range of test equipment marketed by University Graham Instruments are the type TV-7001 FET volt-ohm-milliamp meter and the type TC-2 valve tester. Both instruments offer a high order of performance at an attractive price, and should be of interest to both enthusiast and professional.

The FET VOM is a sturdy, general purpose electronic multimeter with some 27 measuring range. It is housed in a black bakelite case measuring 15 x 18 x9cm overall (W x H x D). The case is provided with a handle / tilting bail formed from extruded aluminium.

The instrument has a large 16cm-diagonal meter movement with easily read scales. The main controls are rotary switches for mode and range selection, supplemented by pots for zero and ohms adjustment. There are also two miniature slider switches, one for an internal battery check and the other for input lead polarity reversal.

The circuit of the meter is a fairly conventional one, using two FETs in the familiar balanced bridge configuration. However there are a few noteworthy points, one being that the basic circuit is powered from two penlight cells, giving a supply voltage of only 3V. Despite this low figure, linearity seems to be quite normal.

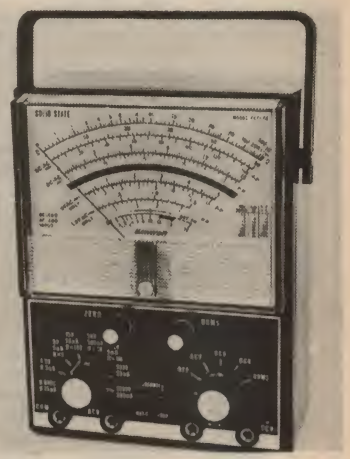
There are no less than 8 DC voltage ranges, with FSD values of 0.5V, 1.5V, 5V, 15V, 50V, 150V, 500V, and 1500V. Input impedance is constant at 12M for these ranges, giving very low circuit loading.

The 0.5V range is dropped for AC voltage, no doubt because of rectifier linearity problems. This still leaves seven ranges, with an input impedance of 1M. The rectifier used is a bipolar voltage doubler type, so that the readings are basically peak-to-peak. As usual the indicated reading is scaled in terms of equivalent sinewave RMS, but the equivalent P-P values are also shown for greater flexibility. Frequency coverage of the basic meter on AC ranges is quoted as 30Hz — 5MHz, within 3dB.

There are four resistance ranges, with centre scale values of 10 ohms, 1k, 10k and 10M respectively. This gives an overall resistance measuring capability of from about 0.1 ohm to 1000 megohms. Power for the resistance ranges comes from a second pair of penlight cells.

In addition to the above ranges, which one would more or less expect to find, there are also a full 8 "DC current" ranges. These cover from 0.15uA to 500mA FSD, and thus offer an overall current measuring capability of from about 2 nA (yes, that's right — 2 nanoamps!) to 500mA. Terminal voltage is 300mV. A very impressive feature, and one which should enhance the appeal of the unit quite considerably.

Rated accuracy of the instrument on all but the 1.5V AC range is plus/minus 3pc, with the single mentioned range only slightly less accurate at plus/minus 4pc.



As mentioned earlier, a switch is provided for checking the battery. It is also worth noting that the meter movement is shorted out in the OFF switch position, so that it will be damped for shock protection during transport.

A look inside the sample unit submitted for review revealed that the meter is solidly made. Most of the minor components are mounted on a small printed board, which is arranged for convenient servicing if necessary.

In operation, the unit gave a good account of itself. Electrical zero and calibration stability was generally good, although we did notice that the zero setting was different for the resistance ranges compared with the other ranges. This may have been a peculiarity of the sample; if not it could be a nuisance in routine use.

Apart from this we couldn't fault the unit, and would rate it as a very nice little meter.

The model TC-2 valve tester is an instrument of more limited application. It is basically a low cost shorts-filament continuity-emission tester for the service technician, hobbyist and radio amateur.

It is provided with four valve sockets, for the tubes now in use. Pin allocation is by means of 10 slider switches; filament voltage selection by a rotary switch; plate load by means of a pot, and test function by a button.

A set of data charts with instructions is mounted in a small drawer fitted into the bottom of the case, making the unit easy and convenient to use.

Although it is not capable of making serious measurements of valve parameters, the unit is quite sufficient for performing the vast majority of "is it OK or a dud?" valve tests. It would therefore seem quite suitable for anyone seeking a simple, low cost valve tester.

Price of the FET multimeter is quoted as $72, while the valve tester is $46 (plus 15pc sales tax in both cases, where applicable). Both are available ex stock from University Grahan Instruments, or on order from their agents in each state.

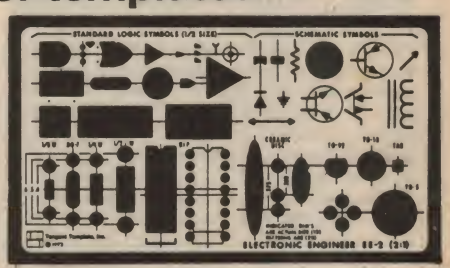
Both instruments have a 90-day guarantee period, and University Graham offer a 24-hour repair service should the instruments need attention.

Enquiries regarding these instruments, and others in the range, should be directed to University Graham Instruments Pty Ltd at 106 Belmore Road North, Riverwood, NSW 2210, or their interstate agents. (J.R.)

Logic & circuit symbol templates

Most people in electronics, whether amateur or professional, have to draw reasonably neat circuit and logic diagrams from time to time. These jobs can be made considerably easier and less tedious by the use of a transparent template having cutouts for most of the commonly used symbols. The "Electronic Engineer" templates produced by Tangent Template Inc are designed for this very purpose.

There are three different templates in the range, each offering a complete set of standard logic cymbols (ANSI Y32.1) as well as most of the usual circuit symbols. The three versions differ only in terms of size: EE-1 is nominally 1:1, EE-2 is 2:1, and EE-4 is 4:1. Prices are $4, $5 and $7 respectively.



The templates are available from the sole Australian agents, WHK Electronic & Scientific Instrumentation, P.O. Box 147, St Albans 3021.

NEW PRODUCTS

Miniature DMM from Data Precision

Those needing a compact battery operated precision measuring instrument should find the Data Precision model 245 digital multimeter of particular interest. It features 4½-decade resolution and .05pc accuracy.

Physically, the model 245 is a "little brother" to the model 124 reviewed in the August issue: it measures a mere 14 x 5 x 10cm overall (W x H x D), and weighs only 590 grams. Yet electrically it is capable of considerably higher performance. Maximum resolution is improved by a factor of 10 on most ranges, while accuracy is at least 3 times better. And in addition it offers the advantage of self-contained battery operation.

The readout is of 4½ digits, one more than for the 124, but uses the same Sperry-type planar gas discharge tubes. These have a smaller character size, in keeping with the compact format: character height is about 8mm, which is still highly readable even at a distance of a couple of metres.

The case appears to be moulded from high impact resistant plastic — Cycolac or similar.

There are 21 ranges in all: four each for DC and AC voltage and current, and five for resistance. These give an overall measurement capability from 100uV to 1000V DC, 100uV to 500V AC, 1uA to 2A for both DC and AC, and 100 milliohms to 20M. In each case the first of the above figures represents maximum resolution, and the second maximum effective FSD with over-range. Quoted accuracy over a period of 6 months is plus/minus .05pc and 11sd for DC volts, with corresponding figures of .08pc for AC volts, 0.1pc for DC, 0.3pc for AC and .07pc for resistance.

The model 245 uses the dual-slope integration technique, with automatic polarity selection (but manual range selection). It has a 50dB normal mode AC rejection at both 50 and 60Hz. Reading rate is 2.5 per sec.

Power is provided by an inbuilt NiCd battery module, which will run the instrument for 6 hours between charges. The 245 comes complete with specially designed charger (245E), and may be used with the charger connected if desired.

Enquiries regarding the model 245 should be directed to Kennelec Systems at 142 Highbury Rd, Burwood, Victoria, or 48 Oxford St, Paddington, NSW, or their representatives.

Conducting tape for hidden wiring

If you've ever wanted to conceal the wires to your intercom, electric doorbell, or burglar alarm, then here is the very product, Conduct-o-tape. It can be buried under wall-paper or painted over, so that it is well-nigh invisible.

Conduct-o-tape is a clear adhesive tape with two continuous 1.5mm wide copper strips on the adhesive side, which is normally protected by a paper backing tape. To apply the tape, the paper backing is peeled off and the tape run along the wall or what ever. It can be buried under the wall-paper without any tell-tale ridges or it can be painted over and depending on the wall texture and paint, it can be almost impossible to detect.

Miniature plugs and sockets are also available. The sockets, which are fastened with adhesive to the wall surface, are supplied with a short length of Conduct-o-tape to enable them to be spliced into the concealed tape. A mating plug and two-core flex completes the connection to the appliance.

The length of a roll of tape is 50 feet but it can be spliced to make any length. It is claimed to be suitable for any low voltage application and is rated for currents at up to an amp or so. If it was used at currents approaching an amp, care would probably have to be taken to ensure that the splices had low contact resistance.

Two applications which occurred to us were as a noise-cancelling loop aerial for an AM tuner and perhaps even as an indoor TV antenna or lead-in — the characteristic impedance may not be very far away from the required 300 ohms. Time did not permit us to try out these applications.

One application that Conduct-o-tape is not really suitable for is to connect loudspeakers to an amplifier in a high-fidelity sound system. Total resistance of a 50 feet length of tape is 4 ohms which does not include contact resistance. This would mean serious power losses and a reduction in damping factor in the system.

Conduct-o-tape is available from electronic parts suppliers who can supply further information or contact the distributors, Ralmar Agencies Pty Ltd, 71-73 Chandos St, St Leonards, NSW 2065, or interstate representatives.

Books & Literature

TV pocketbook

TELEVISION ENGINEERS' POCKET BOOK, edited by P.J. McGoldrick. Published by Newnes — Butterworths, London, 1973. Hard covers, 130 x 192, 372pp, many circuits and diagrams. Price in Australia $7.30.

This is the sixth edition of the well-known Television Pocket Book, which was first published by Newnes in 1954. It has been very extensively revised and updated, with a large amount of new material covering such areas as colour TV, solid state circuits, ICs and servicing.

Written at what can best be described as "thoroughgoing qualitative" level, the book is more than ever before a sound and practical introduction to television receivers and their operation. While in places fairly strongly orientated towards the UK situation, it none the less gives a very great deal of broad and basic theory.

As a result, it would seem a good choice for the student, hobbyist or trainee technician who wants a readable and satisfying introductory text. At the price quoted it is also good value for money.

The review copy came from the local office of the publisher, but local bookstores should have stocks by the time this is printed. (J.R.)

Antenna manual

THE ARRL ANTENNA BOOK, published by the American Radio Relay League, Inc., Newington, Connecticut, 1874. Soft covers, 165 x 242mm, 336pp, many photographs and diagrams. Price in Australia $4.50 plus 50c postage.

This is again a new edition of a well-known book — in this case the thirteenth edition of what has virtually become the radio amateur's "bible" on antennas and transmission lines. The first edition of the ARRL Antenna Book was published no less than 25 years ago, and in the years since then countless amateurs and SWL's have found it of great value.

This time the book has received what is probably its most extensive revision to date, and there are some noteworthy additions. One in particular should be much appreciated: a thorough and well-written section on the use of the Smith Chart in solving transmission line problems. There are also sections on design and construction of log-periodic antennas, and new practical HF configurations such as a 40-metre "sloper". Material has also been added on rotator and tower delection.

There are four new chapters. One on antennas for restricted space, on space communications antennas, one on measurements, and finally one on specialised or esoteric antennas such as discones and "beverage can specials".

More than ever before, then, a very sound and down-to-earth reverence manual on antennas, and one which should be of value to the college and engineering student as well as the radio amateur.

My only complaint is that I couldn't find any information on the use of trees as HF antennas. The US army is reported to have achieved good results in this direction, and it would have been interesting to see some discussion of the technique used. Perhaps we will find it in the 14th edition!

The review copy came from the Technical Book and Magazine Co of 289-299 Swanton St Melbourne, who advise that they have copies in stock. (J.R.)

CMOS status report

CMOS INTEGRATED CIRCUITS — A STATUS REPORT, by Graham A. Rigby, PhD. Published by AWA Microelectronics Ltd, Rydalmere, NSW (reprinted from Australian Electronics Engineering). Brochure, 5pp.

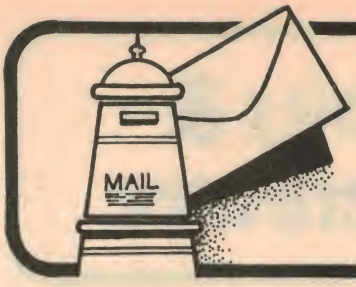
This is a reprint of a recent review paper published by Dr Graham Rigby of AWA Microelectronics, surveying the status of CMOS integrated circuits at the current state of the art.

After an introduction, it deals with the construction and operation of the basic CMOS gate and then passes on the discuss internal circuit design, CMOS-bipolar compatibility, low voltage CMOS, high speed CMOS, CMOS LSI, and custom CMOS.

There is naturally an emphasis on the viewpoint of a device designer and manufacturer, as one would expect. However user orientated aspects such as performance and applications are also discussed, making the paper an informative and satisfying review.

Well worth reading, if you would like to know more about this important logic family.

The reprint is available free and post free from AWA Microelectronics, at 348 Victoria Road, Rydalmere NSW 2116. (J.R.)



Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

Component situation

In January you up-dated your Laser article and I decided to build it. I wrote to Laser Electronics for the tube and received it promptly and beautifully packed. I left an order with J. H. Magrath for the transformer and sat back and waited. Incidentally another supplier was not helpful — having written for the price of their diodes I sent an order and a cheque for four — the cheque was returned with a letter that there was a $10.00 minimum on all orders!!

J. H. Magrath did their best but no transformer was available. Early in June I wrote to Laser Electronics and asked if they could help. I received a reply by return mail from a Mrs Patricia Smith (Marketing Executive) offering to help in any way they could. I wrote back immediately. Because of the mail strike there was a slight delay, but within a week I received a small parcel containing the transformer, three .001 5kV caps. and a 1500 VDCW paper cap. and a letter from Mrs Smith.

I quote: "From your letter you appear to have some component trouble (!) . . . Re: Your transformer — I have scrounged through the workshop and have come across a transformer which was out of a bench supply. This transformer was a prototype manufactured for us and will run your tube. The details for connecting are as follows (five lines of details). For this transformer we will charge $5.00 plus postage $2.00 making a total of $7.00 outstanding. The three .001 5kV capacitors have been included at no additional cost."

I am still in a state of shock at the thought of a marketing executive (and a woman) scrounging through a workshop for a transformer for someone who was not really their customer! So Laser Electronics and Mrs Patricia Smith get full marks from me for their care in looking after their products. Need I remark that the absence of transformers means the Laser tubes are useless for ordinary people?

Rev. Fr. J. Dunne, S.J.
Campion College, Kew, Vic

COMMENT: Don't be too eager to condemn the firm who sent back your cheque. With rising labour costs, a great many firms both here and overseas have been forced to adopt a minimum order policy and curtail their services. It's either that, or load all prices to recover the cost. We agree that you received very commendable service from Laser Electronics, but surely they wouldn't be able to repeat the performance for many others — if the truth is known, helping you quite probably involved at least $10 worth of time and labour, quite apart from the components.

Transformers have been scarce recently, particularly those for fairly specialised projects like the laser. But we understand that this situation is now much improved, and getting better.

More on components

May I, as a hobbyist, respond to the letter written by the Sales Manager of IRH Components. Despite the thumping of the nationalist drum, it is our manufacturers and retailers, together with their servants — the Australian Government, that have done their utmost to kill electronics as a hobby here. They have kept the prices high and the design and quality low. A true picture would soon emerge if your magazine took the trouble to ask the experimenter and hobbyist to cite instances of shoddy and negligent goods and services from the industry.

The fact of that matter is, that no parts are imported here from countries whose engineers and technicians are on a subsistence wage. This argument is emotional and untrue! Most assemblers of equipment are unskilled and with the exception of one or two countries, these people earn as much or even more than ours do.

The local scene for the hobbyist is a gloomy one. Constructing projects is a frustrating business. Now I buy much of my parts from England and America. The response is faster, the service is better and even with postage and duty the goods are much cheaper.

J. Brown (East Bentleigh, Vic.)

COMMENT: There is undoubtedly a high emotional content in the argument about overseas wage levels, and in any case rising living standards are gradually making the point irrelevant. But have you told the workers in Taiwan, Singapore, Mexico and the other countries currently favoured for "off-shore" manufacture and assembly how much they are supposed to be earning?

There are considerable problems associated with component availability for the hobbyist, certainly. But many of them arise because Australia is a small, relatively remote market by world standards. Who do you want to blame for that?

Those naughty cm!

The smugness of your reply to R. N. Simpson's letter (August issue) appalled me by its lack of understanding of what the millimetre in particular is all about.

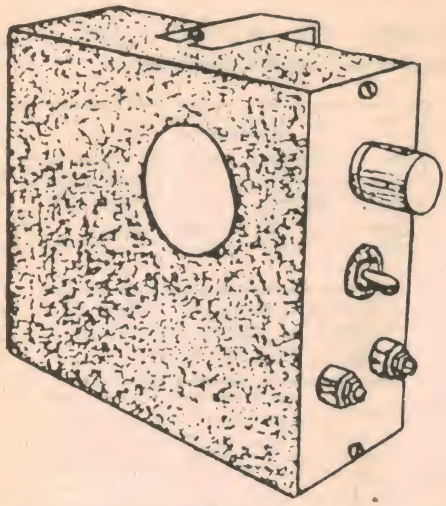
When we have settled down to really using metric units of length and not converted Imperial units, small components, electronic or otherwise, can be more simply expressed in millimetres than centimetres. We will have printed circuit boards designed on a 4 mm module (0.150in equals 3.81 mm); we will have keyways on shafts 8 mm x 7 mm; we will have cases 230 x 215 x 90mm and so on.

In other words, no decimal fractions to worry about, other than in industries currently using thousandths of an inch which will be replaced by hundredths of a millimetre.

The size 4mm is far less clumsy than 0.4cm; 215mm is shorter than 21.5cm and believe it or not, is easily resolved as the same length!

J. A. Bennet (Revesby, NSW)

COMMENT: On the other hand, 34cm is shorter than 340mm, and it too is easily resolved as the same length. Frankly, we remain puzzled by the vehemence of the campaign against the centimetre. For measurements from a few tens of mm up to a metre, it seems a logical and convenient unit, worthy of a place alongside both mm and metres.



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Uses NO light beams — works on a sudden variation of room light. ie when someone walks in front of it. Range approx 10 feet. Battery operated — takes 6 penlite cells. Replace batteries only 2 to 3 times a year. Built in speaker produces adjustable loud or soft tone. Whole unit is self contained and can be fitted by ANYONE in minutes. No external wiring needed. Provision for remote extension. Thousands sold in NZ. Replaces every other shop alarm on the market. Complete and ready to go (minus batteries).

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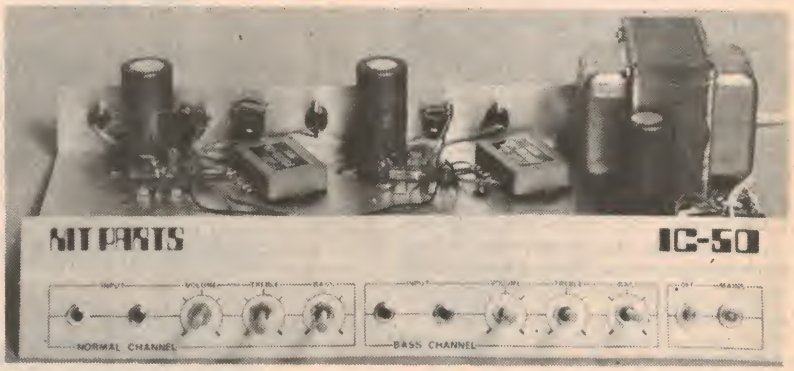
HOMODYNE TUNER KITSET

(from Electronics Australia) Complete with attractive anodised cabinet and silk screened front. $25.00.



50 WATT GUITAR AMPLIFIER

Introducing our fabulous 50 Watt guitar amplifier kitset — using a new technique for your protection. Both preamps and main amps are duplicated, and internally wired together, so that in the unlikely event of one channel developing a fault the other will continue to operate.

Look at these features ...

- Feeds two speaker cabinets with 25 watts each. This gives a total genuine power output of 50 WATTS RMS.
- Unique tone control circuitry provides wide range of tones for Lead Guitar, Rythme Guitar, Bass Guitar, Organ, and P.A.
- The preamps and power amps have been preassembled and tested so the total assembly time of your kit should not exceed 6 - 8 hours.
- Very little electronic knowledge is required to assemble this kit, mainly the ability to use a soldering iron.
- The output stages are Intergrated circuit devices and are protected by fuses in case of a loudspeaker short. The entire amplifier consists of transistors and integrated circuits.
- The unit is supplied with prepunched chassis (most parts already mounted for you), an attractive vinyl covered wooden cabinet, and highly attractive front panel. The unit, when completed, looks fully commercial.
- The unit is half the weight of current outdated commercial units, and about half the price.

Why pay over $300 for a unit — our price is only **$199** **Add $5 freight to Australia & Islands**

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catalogue

The Amateur Bands

by Pierce Healy, VK2APQ

17th Jamboree-On-The-Air

This event, held each year, gives Boy Scouts and Girl Guides the opportunity, through amateur radio, to exchange greetings and personal expressions of good fellowship on a scale not practicable through the usual communications channels.

The 17th Jamboree-on-the Air will be held on the weekend 19th-20th October, 1974, from 0001 hours local time Saturday to 2359 hours local time Sunday.

It is not a contest. There are no awards for outstanding DX contacts, rare countries worked, or number of contacts. It is simply an opportunity for the expression of goodwill and fellowship between the youth of all nations.

During the 1973 JOTA the youth of 87 countries participated. They ranged from groups in small emerging nations to those in the larger and more technically advanced countries. It allowed those from remote, sparcely inhabited areas to learn first hand of the life and activities in large towns and cities. By contrast, it gave those in the cities a knowledge of life away from the pressures and demands of thickly populated areas.

To the amateur it is an opportunity to provide a service to his community, and can be rewarding and educational.

There are three basic rules for the event:—

Amateurs enter by calling "CQ Jamboree" or by answering other stations heard using that call.

Any authorised frequency or mode may be used.

All participants must strictly observe the terms of their licence.

Many interesting points are contained in the report on the 1973 JOTA, published by the World Scout Bureau, in Geneva, Switzerland.

Here are some interesting snippets from the report, received from Australian JOTA Organiser, Noel Lynch, VK4ZNI.

The Japan Expo 70, Commemorative Fund supports the JOTA project. Through this grant the Bureau was able to distribute 100,000 official JOTA posters to 150 locations around the world.

In Australia and Papua-New Guinea, 507 amateur stations participated. In Papua-New Guinea, VK9HT operated from the Lae Show where most of the 10,000 visitors saw the station in operation. From here a Danish girl guide was able to have a long contact in her native tongue with a JOTA station in Denmark.

Another Papua-New Guinea station, VK9IF, may have a claim for a JOTA first, for contacts with Scouts in Hawaii, Tokyo and Wellington (NZ), via amateur satellite OSCAR VI.

In Brazil 427 stations made 3536 contacts with foreign Scout groups and 115,944 contacts with stations within Brazil.

In Ireland, E1ALB was aboard the Scout training ship, Albatross. Scouts from various Dublin units went aboard for the weekend and, despite the rough weather, many contacts were made.

Apart from amateur stations in Malaysia, the military network was particularly helpful. It enabled Scouts of the Sg. Buloh Leper Camp and the Serendah Boys' Home to take part in JOTA for the first time.

The efforts of the Tuhoa District Scouts (New Zealand) to interest amateurs in the JOTA resulted in re-starting the local radio club after a period of hibernation. In Timaru, a group of Venturers were given an interesting lesson in wine making from a German station.

JOTA station CT1IN, in Faro, Portugal, did its "good turn" by helping, through a contact with a British station in London, to find a special medicine needed for a seriously ill, 9-year-old boy. Two other stations, CT1JAM and CT1CNE were featured in a 15-minute film made to give "the idea of JOTA to Portuguese youth". The film was shown on TV.

Four stations operated from the Azores, all with special call signs: — CT2CNE; CT2AEP; CT2JAM and CT2BSA, the latter on behalf of an American Scout Troup. The press and TV gave excellent coverage and a special postmark was in use.

In the town of Vasteras five stations were operating. One group arranged a competition for their neighbours, and provided baby sitters when necessary, so that parents could join in the program. The event finished with a big campfire.

Co-operation between Scouts and amateurs has increased and the Scouts now have a special column in the amateur magazine.

In the United Kingdom the national organiser is Les Mitchell, G3BHK, to whom the credit for suggesting and organising the first JOTA is acknowledged. Poor propagation conditions prevented a large number of DX contacts being made. However, one group in Birmingham learned all about Apple Day in Canada from a Scout group on Prince Edward Island.

Nearly one third of the Scout groups in Uruguay took part from the station of National Organiser, CX6AZ, in Montevideo. Special permission was given which allowed scouts to talk from an amateur station during the period of JOTA. The boys were thrilled to talk to an aircraft flying at 9000 metres over the USA.

In Finland "Radio Scouting" is regarded as a year-round activity and the event saw two newly licensed scouts, OH3FO and OH6JX participating with home-built, crystal-controlled transmitters. Several stations operated on two metres FM for local contacts.

World JOTA organiser, Len Jarrett, HB9AMS, operated the World Scout Bureau station, HB9S, from the top of Mount Chasseron, some 100km north of Geneva, Switzerland, 1600m high. Fine sunny weather on Friday afternoon changed and Saturday and Sunday was spent above or in the clouds with winds up to 100km per hour.

Operation commenced about 2000 GMT on the Friday evening and continued until around 2200 GMT Sunday, almost 50 hours non-stop.

Conditions within Europe were consistently good, but to other parts of the world it was spasmodic. However, the Scout groups contacted totalled over 200 and included over 30 different countries.

The operators at HB9S could speak several languages, and were able to talk with non-English speaking groups.

Scouts and Girl Guides in the Netherlands treated the JOTA as a joint venture, and this appeared to be a great success. Dutch stations participating increased by 25pc over the previous year.

Scouting Nederland was honoured by the presence of Her Majesty Queen Juliana at the opening of their new headquarters building on the Saturday, JOTA station PA0PHK/A taking part in the ceremonies.

Eight stations operated north of the arctic circle in Norway and, for the first time in the history of JOTA, Scouts operated from Jan Mayen Island. The call signs were JX1DM and JX2FL.

The impact of JOTA in Norway is outstanding. During 1973, Radio Scouting became an integral part of the Scouting program, organised by the Norwegian Radio Scouting Committee. The committee, consisting of amateurs, has co-ordinated courses and instruction in radio at camps seminars and similar gatherings. It also has a large kit-building program. Monthly Scout nets have been organised and a Radio Scouting column edited for inclusion each month in the Norwegian amateur radio bulletin.

In 1973, for the first time, Radio Scouting was adopted in the program at the Norwegian Girl Guides Association National Camp. Some 2400 participants took part in camp courses on radio theory and allied subjects. The call sign of the NGGA is LA2SS.

New regulations introduced in Norway this year have made it easier for Scouts to obtain their amateur licence. For candidates 14 years or older, a novice licence has been introduced.

A large number of Scout troops are arranging their own radio amateur courses headed by amateurs within their ranks.

Two aspects of JOTA worth noting are: — the excellent public relations created in many countries, on both governmental and local community levels. The other is the excellent opportunity for the promotion of amateur radio as a worthwhile activity within a community.

Bulletins on the 17th Jamboree-on-the-Air have been issued to branch organisers and Girl Guides Association with suggestions for those wishing to participate. Amateurs wishing to do so should contact their local Scout or Guide group or their branch organiser.

Branch organisers are:—

Queensland — Commissioner Ian Clarke, C/- Q'land Branch Headquarters, The Scout Association of Australia, PO Box 50, Broadway, Brisbane, 4000.

NSW — Commissioner Ray Lawrence, C/- NSW Branch Headquarters, 283 Clarence Street, Sydney, 2000.

Victoria — To be appointed.

Tasmania — District Commissioner Ken Lane, 15 Nelumie Street, Lindisfarne, Tasmania, 7015.

South Australia — Steve Johnston, VK5ZNJ, Flat 14, 13 Balmoral Road, Salisbury East, 5109.

Western Australia — Commissioner Peter Hughes, VK6HU, 58 Preston Street, Como, 6152.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

LOCAL AND OVERSEAS NEWS

REGION I

UK 10GHz Record

A new United Kingdom record for a two-way contact on the 10GHz band was set on 11th May, 1974. The distance, 243km, exceeds the previous record of 212km set in September 1973. The contact was between GW4BRS, a Barry Radio Society group consisting of GW4AMV, GW3PPF and GW8FGT on Snowdon 1086 metres above sea level in Wales and GM30XX with GM3DXJ up Cairnsmore of Carsphairn in Scotland, 796 metres above sea level. Both groups experienced very bad weather conditions. In Scotland it was rain, hail, sleet and fog, while in Wales it was continuous rain and fog.

The Scottish signals were reported as being about 10dB above the noise and the Welsh as S2 with some QSB.

The equipment was quite small, nominally 10mW Gunn oscillators to dish antennas around 700mm diameter. A rough check suggests that the equipment had a path loss capability of 165-175dB. The calculated path loss, assuming the free space value, is 161dB, so the calculated reserve was 4-14dB. This value agrees quite well with the actual signal strengths reported and implies that both pieces of equipment must have been working well and the path loss could not have been much greater than the free space value. (Rad. Comm. June 1974).

New Prefixes

It has been announced by the International Telecommunication Union that the following call sign series have been provisionally allocated. A9A—A9Z for Bahrain and C4A — C4Z Republic of Cyprus.

REGION II

DXCC Changes

The ARRL have announced two changes in their DXCC countries list. Any contacts made 1st June, 1974 and after with stations in Tibet will be creditable towards the China (BY) listing, while contacts with stations in Zanzibar will be creditable towards the Tanzania (5H3) listing. This makes the maximum possible total 355 countries, with a possible total of 35 deletions. (QST June 1974).

REGION III

VK/ZL Oceania Contest

The NZART and WIA invite world wide participation in the 1974 VK-ZL-Oceania DX contest.

Object: For the stations in other parts of the world to contact stations in that area and vice versa.

Dates: Phone section — 24 hours from 1000GMT Saturday, 5th October, 1974 to 1000GMT Sunday, 13th October, 1974.

CW section — 24 hours from 1000GMT Saturday, 12th October. 1974 to 1000GMT Sunday 13th October.

There will be three main sections:—

a. Transmitting phone.
b. Transmitting CW.
c. Receiving phone and CW combined.

2. The contest is open to amateur stations in any part of the world.

Further details may be obtained from the WIA Contest Manager, Box 679 Post Office East, Melbourne, Victoria 3002, or NZART Contest Manager, 152 Lytton Rd, Gisborne, NZ.

Remembrance Day Address

The opening address for the 1974 Remembrance Day contest was given by the PMG, Senator R. Bishop. The address was transmitted over WIA stations throughout the commonwealth. Senator Bishop said:— "I am honoured to be invited by the Wireless Institute of Australia to open its 27th Remembrance Day Contest.

"This contest is primarily a memorial to the 35 amateur wireless operators who gave their lives in World War II. However, it also serves as an advanced training exercise in the important field of radio-communication.

"Amateur radio, today, is a highly skilled activity and provides a reservoir of competent operators, who are internationally recognised, who relieve the stresses from Government services in times of emergency and who do much to promote better understanding between the peoples of Australia and other countries.

"Looking beyond the next decade the alliance of computers and communication networks in conjunction with new technologies will provide the capabilities for a wide range of new services. The demand for mobile services of all kinds is likely to increase markedly.

"Vast increases can be foreseen in the volume of information conveyed by transmission media, both guided and radiated.

"New guided media, for example, optical fibres, could become the main conveyors of point to point transmission; radio being used predominately for communication with moving objects.

"It is likely that there will be great demand in the future for mobile telephone systems. Micro-miniaturisation and digital techniques could make pocket telephones a reality if a suitable and adequate spectrum can be found.

"New techniques will be developed to exploit the upper reaches of the spectrum — perhaps higher capacity satellites.

"Domestic satellite systems may eventually be expected to provide services for entertainment, education and welfare, and to give outback centres full access to national telecommunication facilities.

"Notwithstanding the rapid progress and specialisation of the electronic art, the amateur is keeping his equipment up-to-date, operating to international standards and himself ready and able to meet any emergency.

"This contest, which I now declare open, is an exercise in skill, speed, efficiency and improvisation in simulating for 24 hours, an emergency communication network. It will demonstrate the valuable and specialised service that radio operators give unstintingly without expecting tangible reward.

"I wish it every success."

RADIO CLUB NEWS

RADIO CLUB DIRECTORY

A final reminder; — for inclusion in the Radio Club Directory, planned for the December issue, details in a format set out in the July issue, must be to hand by the 16th October, 1974.

The aim is to provide information for those holidaying over the Christmas period as well as assistance to those looking for a radio club to join.

Hunter Branch Field Day

The annual Hunter Branch field day WIA will be held on Sunday, 3rd November, 1974. The venue is the Community Hall, Anzac Parade, Teralba, next to the Northumberland Radio Centre. This field day caters for the whole family. All amateurs are invited to bring their families and friends.

Program of events:
0900 hours — Registration.
0930 hours — 2m talk-in hunt.
1000 hours — Morning tea.
1015 hours — 2m pedestrian hunt.
1030 hours — 2m two transmitter hunt.
1145 hours — 40m pedestrian hunt.
1200 hours — Lunch.
1300 hours — 160m pedestrian hunt.
1315 hours — 40m hunt.
1400 hours — All band scramble, HF and VHF.
1430 hours — 2m talk-in hunt.
1515 hours — 2m two transistor hunt.
1630 hours — Prize giving.

Special entertainment for the ladies in the Community Hall from 2.00pm.

Films: Documentary films will be screened from 10.00am.

Quizzes: For ladies, men and YRCS members.

QSL Bureau: The inwards section will be open most of the day.

Points to be observed during contests:—

1. — At least one person other than the driver must be present in each vehicle in mobile events.
2. — All hidden transmitters will be in fixed locations and the frequency and mode will be given at the start of the event.
3. — Transmitters will not be on private porperty and it will not be necessary to cross private land to reach them. It may be necessary to walk the last 100 metres of so to the transmitter.
4. — Road rules and "Handbook" regulations must be observed.
5. — Failure to notify participation in any event may mean disqualification.
6. — In the event of a dispute, the decision of the Hunter Branch executive shall be final.
7. — The "Fox" shall decide the winner of each hunt.

WIA Midland Zone — VK3

The Midland Zone WIA Victorian division has in operation a VHF translator on Channel 2. Location is Mt. Alexander, 800 metres above sea level, the call sign is VK3RAM and power is 10 watts to a folded dipole. It is self identifying and the time cutout is 2.5 minutes.

The Zone has leased a block of ground from the Victorian government and a "Nissen Hut" is being erected for a club room. It is hoped that occupation will be in December.

The object is to stimulate interest, especially among the younger generation, in radio and electronics in general.

For details contact the publicity officer, Col Gibson VK3FO, Lot 29.E, Church Street, Maldon, Vic. 3463. Telephone (STD 054) 75 2245 or 75 2378.

Illawarra Branch

Guest speaker at a recent meeting was John Milton, VK2AQM, Wollongong District Radio Inspector.

During his talk John dealt with many topics relating to the regulations, and answered many questions by those present.

Members expressed their appreciation of the information that John had prepared for them.

Moonbounce report. An E-M-E test was held with ZE5JJ in Rhodesia from the VK2AMW at Dapto, NSW, on 20th July, 1974. Signals from ZE5JJ were heard up to 5dB above the noise but the signals from VK2AMW were not heard in Rhodesia due to background noise from the sun.

Tests were held on 27th and 28th July, 1974, with W1SL, W9WCD, W0EYE and OZ3FYN but no signals were heard except an unidentified station calling VK2AMW.

The new transmitter frequency source was used for the first time and worked well. RTTY echoes from the moon were received.

The tests were conducted by VK2ALU assisted by VK2ZEN and VK2BHL.

Information may be obtained from the secretary, Ian Bowmaker, VK2ZJA, PO Box 110 Dapto, NSW 2530.

Geelong Amateur Radio-TV Club

Alterations to the Geelong Amateur Radio Club rooms are progressing satisfactorily.

The aim is to provide alternative accommodation at the GARC for members to gather, so that on alternate meeting nights licensed members can relax in the library while study classes are conducted in the main meeting room.

For details of the GARC write to the secretary, David Mann, PO Box 520, Geelong 3220.

Moorabbin and District Radio Club

One of the largest attendances was recorded at the July meeting. A number of visitors attended as the result of the publicity gained by club by participation in the "Youth Expo" in the Moorabbin Town Hall.

The main attraction was an auction sale of a large quantity of various types of radio gear. The financial success was due to the efforts of the auctioneers who kept the bidding at a high level and yet at bargain prices.

For information contact the secretary, Michael Park, VK3ASH, 41 Milburn Grove, East St. Kilda, 3183. Telephone 52 5336.

St George Amateur Radio Society

Guest speaker at the July meeting of the St. George Amateur Radio Society was Shanti, 4S7WP, who spoke on "Amateur Radio in Ceylon."

The possibility of dual frequencies for the SGARS net is being considered to encourage participation by VHF members.

Details of the society may be obtained from the secretary M. S. McKenzie, VK2BMM, PO Box 77, Penshurst, NSW 2222 or to monthly meeting on the first Wednesday of each month in the Rockdale Civil Defence Headquarters, Orpington Street, Bexley. Visitors welcome.

Central Coast Amateur Radio Club

Sunday, 23rd February, 1975, will be the date for the annual field day and the venue will be the Gosford Showground. Ross Mudie, VK2ZRQ, is again field day manager and with his team of workers the day is sure to be a success. Over 300 attended the 1974 field day.

At the August general meeting it was decided to purchase a tower and 20 metre beam to go with the Swan 500 transceiver. Arrangements were made to carry out the installation work.

Arrangements are being finalised for the outing to the Warragamba Dam and wild life sanctuary on Sunday, 27th October.

Want to try out that sniffer for the next field day? Be at the CCARC club house, Dandaloo Street, Kariong, at 7.40pm on the first and third Friday of each month. Pedestrian transmitter hunts are conducted prior to the commencement of the meetings.

Susan Wells, CCARC publicity officer, may be contacted on telephone (Gosford) 92 2244, or write to the Secretary, Barry Gibbons, VK2ZUX, PO Box 238, Gosford 2250.

IONOSPHERIC PREDICTIONS FOR OCTOBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open.

10.74

Westlakes Radio Club

The club is ten years old and a resume of happenings during those years is told in the August, 1974 issue of the club's monthly magazine.

The club now fully occupy their own club rooms in York Street, Teralba. It meets on Saturday afternoons and Wednesday nights. YRCS classes are held under Jamie Campbell, VK2YCJ and David Crofts, VK2YBR. AOCP classes are also held, supervised by Keith Howard, VK2AKX.

An invitation is extended to all to visit the new club rooms and inspect the facilities available.

For details contact the secretary, Eric Brockbank, VK2ZOP, Box 1, PO, Teralba 2284.

Maitland Radio Club

An ABC TV unit will visit the Maitland Radio Club to produce a six to seven minute film about the club, its members, and activities. The film will be shown as a segment in the "Target" series. The film will be directed by Mr Grant Harris who visited the club recently.

Ian Lawrence, a fourth form student-at the Maitland Boys High School and a member of the club, is the fifth person in NSW to qualify for the YRCS advanced radio certificate. Ian now holds all five YRCS certificates.

As these notes were being prepared arrangements were being finalised at the MRC for the YRCS state supervisors' conference. This will be the first time the conference has been held outside a capital city.

Central Gippsland Youth Radio Club

The Central Gippsland Youth Radio Club was formed in July, 1972, and has, since that time, been teaching radio. The attendance of 25 has been maintained and the instructors are Brian Young, VK3BBB, and Ted Allchin, VK3YGI.

Up to August, 1974, students attending the classes had obtained 34 YRCS certificates. They were also awarded the 1973, IREE Pennant for non-school clubs.

The club call sign is VK3AYE and the station generally operates at the conclusion of the meeting on the second Tuesday of each month.

The secretary is Brian Young, who will welcome enquiries to PO Box 613, Traralgon, Vic. 3844

University of NSW Amateur Radio Society

The University of NSW Amateur Radio Society holds its meetings each Wednesday from 1.00pm to 2.00pm, in the meeting room of the Stage III building on the University of NSW campus. Visitors are welcome.

The society has suggested a new course for introduction into the YRCS Syllabus, entitled "The Social and Cultural Aspects of the Amateur Service".

The suggestion has been supported by a comprehensive resume of the proposal covering several foolscap sheets. The suggestion seems to have a great deal of merit and has been submitted for discussion at the YRCS state supervisors' conference. ea

Shortwave Scene

by Arthur Cushen, MBE

The American Forces Antarctic Network has been heard on shortwave, and this is the first reported reception of a broadcasting station from the Antarctic region.

A test transmission on 6012kHz was first noted by Dene Lynneberg of Wellington NZ around the middle of July. The station was at first thought to be the Canadian CJCX, but later AFRS programs were observed and the station identified as the American Forces Antarctic Network. Reception was from around 0430GMT to after 1030GMT with some sideband interference on week days from VOA, Greenville, which is on 6015kHz, and is using this frequency from 0600-0800GMT. Subsequently, Bryan Clark of Wellington also heard the transmission, and it has been further observed in Melbourne and Perth during August.

Confirmation of reception was received by Bryan Clark in the form of a teleprinter message from McMurdo Sound. The Chief Radioman at the American base said "In an effort to help the morale of men at South Pole station and other small isolated Antarctic wintering-over stations, we at McMurdo station have been experimenting with shortwave transmissions intended for McMurdo station and New Zealand's Scott Base area only. Our transmissions on 6012kHz utilised a conical monople antenna with 1kW power output from our transmitter."

According to the New Zealand DX Times, which first published this information, the reception was only poor to fair in Wellington, and our own observations have shown a weak signal. In addition, Radio America in Lima, Peru, is now back on 6010kHz, operating all night on an irregular basis, and this has further added to reception difficulties.

NEW ENGLISH SERVICE

Radio Clarin, which operates on 4850kHz from the Dominican Republic with 3kW on a 24 hour-a-day schedule, has received so much mail from overseas listeners that they have introduced an international program. This program, in English, is broadcast at 0030 GMT Monday to Friday, a time which is not entirely suitable for reception in the Pacific.

According to a letter received by Chris Davis of Featherston, NZ, the station stated that they now broadcast "Clarin International", where they read letters that report their transmissions from all over the world. Radio Clarin has a mailing address of Radio Clarin, PO Box 205-2, Santo Domingo, Dominican Republic.

ANTIGUA RELAY

The BBC and the Voice of Germany have combined to build a new relay station in the Caribbean. Located on Antigua, the transmitting complex will house four transmitters of 250kW, two of which will be operated by the BBC and the other two by Deutsche Welle. Plans have only recently been announced, and following the completion of the Malta relay it is expected that the engineers employed by Deutsche Welle will move to Antigua to work on the new project.

The success of a double relay base located in the Caribbean has been proved. Listeners in Australia and New Zealand are well aware of the excellent signals provided by the Radio Nederland relay station on Bonaire, which is broadcasting from the same area as the new Antigua stations Not only has Bonaire improved reception in the Pacific, but it has also immensely improved signals in North and South America, which are difficult to receive direct from Europe.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

BRAZIL BACK ON 15245kHz

Radio Nacional Brazilia, which was widely reported with its new International Service on 15245kHz some months ago, recently made a frequency change to 15445kHz which resulted in poorer reception. The station has now returned to 15245kHz with a much reduced schedule and operates only from 1900-2200GMT for overseas listeners instead of from 1800-2400GMT as previously. The three languages now broadcast are Portuguese at 1900, German at 2000, and English at 2100GMT. The station address is: Radio Nacional Brazilia, International Service, PO Box 07 0173, Brazilia, Federal District, Brazil.

BROADCASTS FROM MALTA

As stated in the June issue, the new Deutsche Welle Relay Station is now operating with transmitters of 250kW and is broadcasting from Cyclops on Malta. The tests were heard during July with excellent reception on several frequencies, and with announcements in English and German requesting reception reports.

As stated recently, these transmitters are also to be used by Radio Canada and, according to the November schedule, the Malta transmitters will relay the CBC International service as follows:

GMT	kHz
0530-0730	6100
2000-2200	6100
1800-2000	6110
2000-2200	7225
0530-0730	7275
1800-2000	9525

The Deutsche Welle test transmissions are being carried out as follows, with broadcasts in German.

GMT	kHz
0120-0400	9745
0120-0510	11865
0440-0515	6065
1600-1750	11705, 17875
1800-1850	7160, 9590
2140-2230	5955
2140-2240	11865
2300-0110	11865, 15225

As well as broadcasts in German from the Deutsche Welle Relay in Malta, Arabic transmissions have also given good reception according to Jack Buckley of Coogee in NSW. The schedule for these transmissions is:

GMT	kHz
0520-0650	6025, 9680
1910-2100	9625, 11850

The frequency of 9625kHz gives the best reception for the 1900GMT transmission signals on 6025kHz from 0520-0650GMT are fair, but suffer interference from Lisbon, Portugal.

OSLO BROADCASTS

The present schedule of Radio Norway in Oslo shows some new frequencies in use for their world-wide services. English broadcasts are heard for the last 30 minutes during the Sunday transmission, while there are two transmissions beamed to the Pacific. These are scheduled from 0700-0830GMT and from 1100-1230GMT, though several of the other transmissions are also well received.

GMT	kHz
0700-0830	11850, 11860, 15175
1100-1230	6185, 15175, 21655, 21730, 25730
1300-1430	9590, 15175, 17825, 21730, 25730
1500-1630	15175, 15345, 17825, 25730
1700-1830	6185, 11860, 21655, 25730
1900-2030	11850, 15175, 17825
2100-2230	9550, 11850, 15175
2300-0030	9645, 11850, 11860
0100-0230	6180, 9645, 11850
0300-0430	6180, 9645, 11850
0300-0430	6180, 9645, 11860
0500-0630	11850, 11860, 17825

GERMANY TESTS ON 3970kHz

Deutsche Welle has been heard with a test transmission on 3970kHz opening at 2030GMT. Our reception has been of a fair signal and this is the first time we have observed the Cologne transmitter using the 75 metre band. It is understood that these tests in German are from 0700-0910GMT and from 2030-2240GMT. The use of 3970kHz at 0700GMT should provide a fair reception this month, with the earlier part of the transmission being best heard in New Zealand and the close down giving best reception in Australia. It is understood that the congestion in the 49 metre band due to the low sun spot count has forced Deutsche Welle to test on this lower frequency band.

HIBB VERIFIES

Recently a new all-night transmission from the Dominican Republic on 5030kHz was identified by Chris Davis of Featherston NZ as Radio "La Nueua Voz del Popagayo". A verification letter has been received, which gives additional information to that which appears in the World Radio Handbook.

According to the letter from Jose M. Rivero Olmedo, Director of Engineering, HIBB operates on 5030kHz, 24 hours a day, and uses the power of 400W. They relay HIBB on 1530kHz, and the address is: Apartado Correos, No 2, La Romana, Dominican Republic.

LISTENING BRIEFS

EUROPE

MONACO: Trans World Radio has been observed on the out-of-band frequency of 6220kHz during broadcasts to Eastern Europe. Transmissions are from 1645-1800GMT, and give fair reception.

GREAT BRITAIN: The BBC World Service, in its transmissions to Australasia, is now using 5975kHz for the period 0545-0730GMT. The World Service is now available on 5975, 7150, 9640 and 11955kHz with the first two frequencies listed closing down at 0730GMT, and the other two frequencies carrying the program up to 0915GMT.

AFRICA

EGYPT: Radio Cairo has been noted on some new frequencies, according to John Mainland of Wellington NZ. A transmission in Spanish is carried on 15335kHz from 0045-0200GMT. The General Arabic program has been heard on 11785kHz at 0630GMT, while another new frequency of 11715kHz has been noted opening at 2330GMT.

NIGERIA: Lagos has been heard on a new frequency by John Eig, Toowoomba, Qld, with an English Stock Market Report followed by morning melodies at 0612GMT. The new frequency was 11770kHz, which gave fair reception.

ASIA

YEMEN: The Yemen Broadcasting Service at Aden verifies reception with a card showing a mast, and gives the power as 100kW. A recent broadcast has been heard on 11770kHz with an English announcement at 1800GMT. The station identifies as "The Voice of South Arabia" and had a popular music program up to 1815GMT, followed by news.

BRUNEI: According to Sweden Calling DXers, Radio Brunei has a service in Malay from 2200-0500GMT, 1100-1215GMT and 1230-1430GMT on 4865 kHz. There is also a program in Iban and Dusun from 1215-1230GMT.

AMERICAS

VENEZUELA: Radio Nacional has been heard broadcasting from Caracas on 6170kHz and opening at 1000GMT. The signal is mixed with the Manila station on the same frequency. Radio Nacional opens with the anthem, and after full identification the station plays classical music.

Radio Mira has verified Chris Davis, Featherston NZ, with a letter in Spanish and a pennant. The station operates on 6015kHz, and the station address is Apartado Aero 165, Tumaco, Venezuela.

BRAZIL: According to Sweden Calling DXers, some new stations are to be put into operation. These include Radio Brazil Novo, which will operate with 30kW. Another new station will be Radio Brazil Ciencia.

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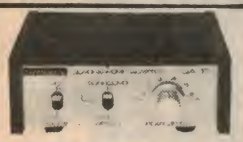

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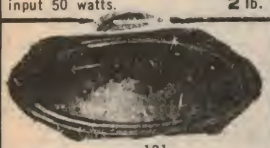

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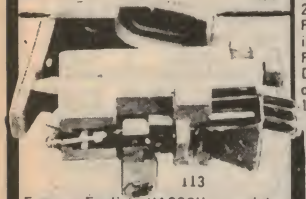

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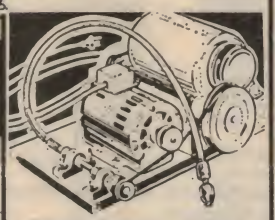

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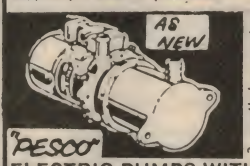

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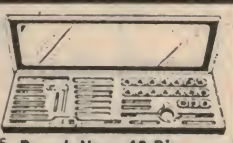

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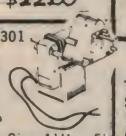

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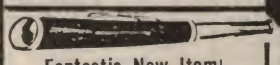

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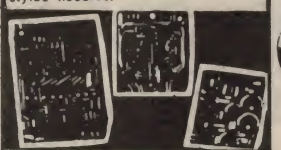

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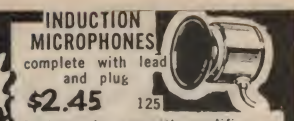

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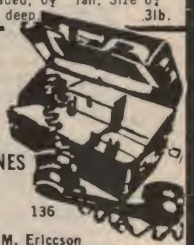

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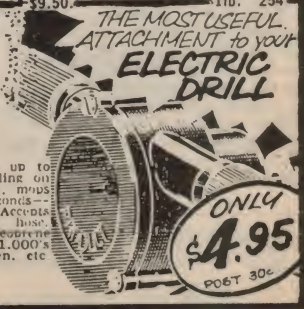

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P & P A. $1.55, B. $1.75, C. $2.25, D. $3.25.

WALKIE TALKIES

2-way radio, 7 transistor, PMG approved, set of 2 only $48.50

1 watt, 11 transistor $130.00 set of 2.

P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85.

SMALL COMPUTER PANELS

3in x 2in containing 2 valves, qty. of resistors, etc.

ONLY 75c P & P 30c.

ELECTRONIC FREQUENCY COUNTER

Austronic type DFC-4 240V 50 cycle 0-100KHz $150

IMPELLER PUMPS

New gunmetal body, Stainless Steel Shaft. Neoprene Impeller. Up to 15ft. Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5"

⅜"	$19.95
½"	$22.75
¾"	$27.50

P & P A. $1.45, B. $1.60, C. $1.75, D. $2.

FREQUENCY METERS

AN URM 32 A 120 KHz to 1000 MHz, with two 40V power supply, $125.00. $1.00 cartage to rail, freight payable at nearest attended railway station.

CONDENSER LENS

2½in DIAM. 2in FL. $1.50 each. Or $2.50 per pair. P & P 20c.

522 Transceivers 100-150MCS

$35.00

Cossor Double Beam Oscilloscope 1035 Tested $150

LOUD HAILER

Battery operated, transistorised. In good used condition $27.50 Post A 70c, B 85c, C $1, D $1.25.

POSTAGE KEY:

A: NSW.
B: Vic, Qld.
C: SA, NT, Tas, New Guinea,
D: WA.

VALVES

BRAND NEW IN CARTONS

807	$1.50	CV850 $1.50
65N7GT	95c	1H6G 75c
5U4G	95c	832 $5.00
EF50	75c	6AG5 80c
5Y3	$1.99	6X4 $1.00
2 x 2	75c	VR64 75c
		VT4C 75c

P & P 30c

PARABOLIC REFLECTORS PYREX MIRROR

36" dia. Ideal solar radio optical experimenting also decorating purposes. $37.50 Sorry shop sales only.

RADAR TRANSCEIVER

X BAND WITH KLYSTRON ETC. $45.00

5" CRO TUBE

5 BTI $5.50 each.

Post: A 85c, B $1.10, C $1.25, D $1.35.

CHASSIS PUNCH SET

Five sizes: ⅜ inch, ¾ inch, ⅞ inch 1 inch and 1⅛ inches. With taper reamer. $13.95

P & P A. $1.45, B $1.60, C. $1.75 D. $1.85.

SELSYN MOTORS MAGSLIP

Md. 11.....$5.25 ea.

No. 19 TWO-WAY RADIOS.

Power supply, accessories, etc., $35.

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PRISMATIC Coated Lenses. Brand new. Complete with case.

7 x 35 Wide Angle	$34.50
8 x 40 Wide Angle	$39.50
7 x 50	$28.65
10 x 50	$29.60
12 x 50	$30.60
20 x 50	$34.45

P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85.

3000 TYPE RELAYS

P.M.G. 200Ohms — 1'500Ohm Coils $2.50 each. P & P 30c.

CASSETTE TAPES

C60 85c C90 $1.20

P & P 20c.

Cintel Oscillator and Electronic Counter, type 388.

$250

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.

P & P A. 60c, B. 85c, C. $1, D. $1.10.

CONDENSER LENS

1½in diam. 1½FL. 50c each.

P & P 20c

BATTERY CHARGERS BRAND NEW WITH METER

plugs into 240V power and gives both 6V and 12V DC output. 4 amps with hi, medium and low charges.

Dimensions, 9" x 5" x 5" $35 value only

$29.50

P & P A. $1.55, B. $1.60

C. $1.95, D. $2.75.

EX ABC RECORDING TAPES TOP BRANDS

¼" x 1200' on 7" reels. $2.50

P & P A. 60c, B. 85c, C. $1, D. $1.10

SOLENOIDS

Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio. etc.

$2.50 P & P 20c

200 MA 24 volt, ⅛in push movement.

$2.50 P & P 20c.

ZOOM FOCUSING MICROSCOPE

Battery and mirror illuminated 900x magnification. Complete with dissecting kit slides etc.

P & P A. $1.45, B. $1.60,

C. $1.75, D. $1.85. $29.95

TRANSCEIVER Ex Army

No 10 set, 38 to 55MHz with hand piece $22.50. Battery to suit $3.50 extra.

No C42 set, 36 to 60 MHz complete with 24V power supply, headphone, mic, leads etc $65.00.

No C45 set, 23 to 38 MHz complete with mast, headphones, mic 24V power supply etc. $95.00.

$1.00 cartage to rail, freight payable at nearest railway station.

Crystal Earphone 75c P & P 20c

Cassette head cleaners $1.50 P & P 20c

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Volts A.C. and D.C. 15 to 1000 volts (3 Scales) Current D.C. 150 M.A. Resistance 1000 K Ohms Only $8.95

P & P 55c

COMMUNICATIONS RECEIVER

TCA R5223 Communications Receivers. These receivers don't cost as much as a R390 A or a RACAL but give you the opportunity of having a unit with a similar performance at a fraction of the cost. Continuous tuning from 1.5 to 30.5 Mhz. bands. First conversion is crystal locked into a 2.5 to 3.5 Mhz tunable second IF. 1 uV sensitivity. Drift from switch on to fully warmed up less than 3 Khz. Dial reset to less than 1 Khz. Calibration to within 3 Khz. (typically within 1 Khz.). Operation from 240V, 110V AC or 24V DC with inbuilt power supplies. 19 inch rack mounting. Accepts coaxial 50 or 75 ohm antennas. Diversity operation possible IF output for panadaptors etc. Complete with leads. headphones a bargain at $250.00 Cartage to rail $1. Freight payable at nearest attended railway station.

A.W.A. SIG GENERATOR

UHF 140-300 MHz $65.00

TRANSPONDER APX6

with Lighthouse Tubes. Can be converted to 1200 MHz. $17

Deitch Bros.

70 OXFORD STREET, SYDNEY 2010

SORRY, NO C.O.D.

INFORMATION CENTRE

SSTV MONITOR: I was very excited when you published the SSTV project in May. However, I have a few questions which other readers who are thinking of building this may like answered. I do not know much about IC's, so is the UA741C the correct component and what do the letters UA and C stand for? Are the TS1201 SCR's (Max current 470mA and PIV 100) suitable replacements for the 2SF106's? I have tried to purchase the two zener diodes (BZX79-C6V2) from my dealer but he said that they are hard to get these days so would you know who has then or is there a suitable replacement?

My last question concerns the power supply. I have in my junk box a 225-0-225V 50mA, 6.3V 2A power transformer. Would this transformer be suitable? Or would a 285-0-285V 60mA with 2, 6.3V 2A windings be better? But even if these were suitable, I would rather use the type of transformer which you used so do you know of any dealer who might have this transformer? Which of the heater windings go to the CRT, the 3A or 1A outputs? How is the monitor coupled to the communications receiver and have any books been published on SSTV? (G.G., Lake Heights, NSW).

Almost any low voltage SCR can be substituted for the 2SF106 in this position; that which you specify should be satisfactory. uA741C is the Fairchild type number for the 741 op amp, but any brand should work.

Almost any 6.2 volt zener diode may be used. If you cannot obtain them you could use a 5.6V type and connect an ordinary silicon diode in series with it to bring the voltage up to 6.2V.

The transformer we used was a low radiation type with a copper strap but we understand it is not widely available.

Perhaps the best compromise for you would be to use the 285V a side transformer and adjust the filtering resistors to give the correct voltages. The rectifier diodes should have a rating of 1000 PIV while the first filter capacitor section should be rated at least 400VW. Either 6.3V winding may be used to power the CRT filament, although the 1A winding was used in the original.

The monitor is connected to the audio output of the receiver. Since the monitor has a low input impedance perhaps the best place to take the signal is from across the loudspeaker terminals.

To our knowledge, not many books have been written on SSTV but you would be wise to check the technical bookstores or the Wireless Institute of Australia. In addition, the latest edition of the ARRL Radio Amateurs' Handbook has a section on SSTV.

CASSETTE TAPE DECK: Some time ago I built the Playmaster 10 + 10 Stereo Amplifier. Recently I fitted a stereo cassette player to my car and now wish to record my own music on tape.

If I purchase a cassette tape deck is it possible to readily adapt it to record from the 10 + 10 amplifier? Would another pre-amp be necessary, and do all cassette decks have the same output? (B.W., Findon, SA).

Answering your queries in reverse order, most cassette decks have the same nominal outputs, particularly those of Japanese origin. A separate preamplifier should not be necessary, as the 10 + 10 has adequate sensitivity. To connect to the amplifier, replace the 3 pin DIN socket used for the auxiliary input with a 5 pin one, and wire it in similar fashion to the tape socket on the Playmaster 140. (See diagram on page 33 of December, 1973, issue.)

The most suitable place for obtaining the recording signal would be from the active end of the volume control, at the negative end of the 10uF coupling capacitors, and with a 10k series resistor in series for isolation. Use a standard 5 pin DIN connection cord to connect between the amplifier and the cassette deck, which should come equipped with a standard socket.

HIGH POWER AMPLIFIER: I am a reader who has built the Playmaster 136 Stereo Amplifier, and while this has fulfilled my requirements to date, I now require an amplifier with a higher power output — somewhere in the vicinity of 100 to 150W continuous.

I was intending to build the Playmaster 127/128 combination, but certain suppliers believe that the design has now been outdated. Therefore, have you any plans for designing a power amplifier with a power rating of approximately 100W and do you intend to update the Playmaster 127 Control Unit?

Congratulations on firstclass designs in the past. (M.O., Bentleigh, Vic.)

We have no plans at this stage for describing an amplifier with a power rating such as you envisage. Recent design trends have tended to favour the integrated amplifier approach (ie incorporating the power amplifiers, preamplifiers and tone controls into one unit), and this will probably be our design philosophy for the present.

Apart from the Playmaster 127/128 combination, the only other high power stereo amplifier design we have published is the Playmaster 132 Stereo Amplifier (40W per channel) which was featured in the June, 1971, and July, 1971, issues (File Nos 1/SA/35 and 1/SA/36) and in the May, 1974, issue.

Kits for the Playmaster 127/128 were advertised in the latest catalogue from the parts supplier mentioned in your letter and, as such, should still be available. However, we would tend to agree that the design is perhaps becoming a little dated, as it is almost five years old.

Thank you for your comments regarding the magazine.

DEAD LETTER: We are holding a letter addressed to Mr E. F. Shield, 13 Arlington St, Eight Mile Plains, Queensland 4123. This has been returned by the postal authorities marked "Left Address". We request Mr Shield to advise us of his current address.

JOINED THE CLUB! Today I bought your magazine and I've found it very interesting. It's the first time I have bought it, and I have found it very comprehensive — so I filled in the subscription coupon, and joined the club! As a beginner I would like to ask for details of a good radio set, strong and reliable. I wish to get in touch with the other side of the world — States and Sth America (F.P., no address given).

Thank you for the kind remarks F.P., and we are glad you like the magazine. Regarding the set you require, we assume that your use of the phrase "get in touch with" implies a transmitter as well as a receiver. We have described a number of receivers and transmitters, designed for use on the amateur bands, but we would need to know which bands you are licensed to use before we could select something for you. If you do not have an amateur licence, be aware that the use of any transmitter, without an appropriate licence, is a serious offence, punishable by heavy penalties. If you wish to study for a licence, we suggest you get in touch with the Wireless Institute of Australia, who have literature and study courses available.

ENLARGING METERS: Could you please tell me whether you have published any projects in Electronics Australia regarding photographic enlarging meters and also the price of CdS cells. (K. S., Boonah, Qld).

We have never described such a device as a project. For information on the price of CdS cells, we suggest you contact your normal parts supplier — he's the one who is in the best position to help.

DEAD LETTER: We are holding a letter addressed to Mr I. Davidson, Smith St, Salisbury East, South Australia, 5109. This has been returned by the postal authorities marked "Not known". If Mr Davidson will supply his current address, we will forward the letter to him.

ELECTRIC GUITARS: Despite my efforts, I have been unable to find any information on construction and fundamental principles of magnetic pickups for electric guitars. Can you help? (J.W., Armidale, NSW).

Not very much, we're afraid. Way back in August, 1948, we described an electric guitar, but this is now so out of date the article is hardly worth considering. Still, it may give you some of the fundamentals you are seeking. Reprints are available — please ask for File No 1/GA/2.

IMPEDANCE PROBLEMS: In regard to your PA Amplifier/Mixer as featured in the June, 1972, issue, are you absolutely certain that it is designed for microphones having an impedance of 100k. The highest impedance microphone that I have been able to locate in Adelaide, Melbourne, or Mt Gambier is 50k. Can you

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INFORMATION

help by supplying me with the name of a firm where I can obtain a 100k unit? If not, is there any way of overcoming impedance matching problems with a 50k unit? (G.S., Lucindale, SA.)

There are no impedance matching problems G.S. The input impedance has been purposely designed to be higher than the impedance of the microphone so that the microphone is not loaded when it is connected to the amplifier. The input impedance of the two microphone inputs is correctly stated in the specifications panel and in the text as 100k. As such, the inputs are suitable for medium to high impedance dynamic microphones, and this includes those types having an impedance greater than 10k. A microphone having an impedance of 50k is therefore quite suitable for this amplifier.

DEAD LETTER: We are holding a letter addressed to Mr R. Bourne, 32 Willow Ave, Manningham, SA5086. This has been returned by the postal authorities marked "Unclaimed" (from two addresses). If Mr Bourne will advise us of his present address we will forward the letter to him.

GAS SENSOR: I have a query about the interesting TGS gas sensor featured in the June issue (File 3/MS/47). What is its reaction time when used, for example, with exhaust gases? If it takes two to five minutes to give a true reading after standing, how fast will it show a reduction of carbon monoxide after adjustment of the carburettor? (R.B., Port Lincoln, SA).

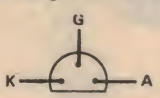
While the gas sensor does have a relatively long stabilising time when it is first turned on, its response time is quite rapid to changes of gas composition and this is within a few seconds for quite small changes in concentration of pollutants. In other words it should give a good indication of exhaust gas changes as a carburettor is adjusted.

NOTES & ERRATA

CRYSTAL LOCKED MUSICAL TONE GENERATOR (August 1974, File No 1/EM/33). The 10k pull-up resistor for the output buffers of the tone generator has been shown in the incorrect position in the component overlay on page 75. It should be connected between pin 14 of the left-hand 7493 and the +V rail, and not between pin 14 and the +5V rail of the right-hand 7493 as shown. The resistor is shown in the correct position in the photograph on page 76.

PLAYMASTER 141 and 142 (Low Cost, Compact Home Stereo Systems) (June and July 1974, File No. 1/SA/49 and 1/SA/51): The bass and treble control potentiometers should obey a linear law and not a logarithmic law as stated in the parts lists.

AUTOMATIC BATTERY CHARGER (October 1971, 2/BC/9): The base diagram for the C103Y SCR as indicated on the circuit diagram is incorrect. The leads are in a triangular configuration as shown.



C103Y

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-20 $20.00

Postage $1.00.

20,000 Ohms per volt DC.
10,000 Ohms per Volt AC.

Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current, 50uA, 25mA, 250mA.
Resistance: 7K, 700K, 7M.
Decibels: —10, +22 (at AC/10V)
+20, +36 (at AC/50V). Upper frequency limit 7KHZ.
Batteries: Two 1.5V dry cells.
Complete with test leads

MODEL RH-80 $22.00

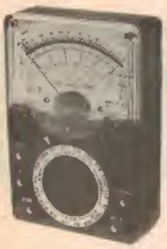
Packing & Postage $1.00.

20,000 Ohms per volt DC.
10,000 Ohms per volt AC.

Specifications:
DC Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5M.
Decibels: —10dB + 62dB.
Accuracy: DC 3pc.
AC 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

MODEL RH-60 $29.00

Packing & Postage $1.00

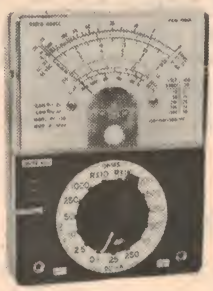


50,000 ohms per Volt DC.
10,000 Ohms per Volt AC.

Specifications:
DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA
Resistance: 10K, 100K, 1M, 10M.
Decibels: —10 +62dB.
Accuracy: DC ±3 pc., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

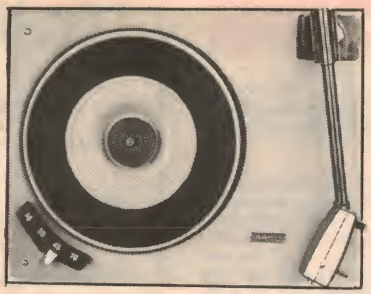
"HANDYMAN" RH-150 $14.75

CHECKED PACKED & POSTED $15.50



Pocket size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS:
DC Volts: 2.5, 10, 50, 250, 1000. 10,000 ohms per volt
AC Volts: 10, 50, 250, 500, 1000. DC Current: .1, 25, 250mA. Resistance: 20K and 2M. Decibels: —20dB, +62dB, 0.7KHz.
Capacitance: .0001, 01, .0025, 25uF.



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Marine Band	(MB) 1.5-4. OMHz	455KHz
International Short Wave — 1	(SW1) 4-6MHz	455KHz
International Short Wave — 2	(SW2) 6-12MHz	455KHz
International Short Wave — 3	(SW3) 12-16MHz	455KHz
International Short Wave — 4	(SW4) 16-24MHz	455KHz
Frequency Modulation	(FM) 88-108MHz	10.7MHz
Aircraft	(VHF1) 108-140MHz	10.7MHz
Police Band	(VHF2) 140-173MHz	10.7MHz
Weather Band	(WB) 162.40-162.55MHz	

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Built-in Telescopic antenna for SW1, SW2, SW3, SW4, FM, VHF1, VHF2, WB (swivel-type telescopic directional antenna).

3. **Output Power**
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DC6V: UM-1 ("D") size flashlight battery x 4, or 240 Volts.
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7. Dimension 11" (H) x 13" (W) x 5" (D).
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Four ranges: 0-15, 0-50, 0-150 & 0-500V
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0-10k, 0-100k & 0-1M ohms, ± 3pc.
RESISTANCE (Resistor substitution.
CAPACITANCE (Capacitance substitution)
Five values: .002uF, .005uF, .02uF, 0.1uF
RF FIELD (RF Field strength meter)
Frequency range 1 — 140MHz
DC 500mA (DC Ammeter)
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This month's Super Special is the Audio I.C. PA234 1w R.M.S. including circuit diagram — $1.25 ea. or 4 for $4, (Never to be repeated). Car Radio Push-button Tuners, complete (suit homodyne) — Only $2 ea. Min. Tuning Capacitor suitable small I.C. Radio — 2 for $1.50. Larger Tuning Cap. 2 gang — $1.50, 3 gang — $2. Slide switches (18 pin) — 4 for $1. Power switches, 4 pos. push-button exc. qual. — 2 for $1, MICRO switches 250v, 10A — 2 for $1. Preset Pots 250k — 10 for 80c. Miniature Coils Osc. and I.F. mixed, unmarked — 20 for $1.50. Power Resistors, Top Quality, High stability — 6k, 4.7k, 5.6k (7W), 6.8k (6W), 15k (4w), 2.7k (5w) — 10 for $1. TRIACS 40485 (R.C.A.) — 3 for $1 (Sell out). POLYESTER CAPS Philips Tubular 400v .001, .0047, .033uf — any 20 for $1. Green Cap + 10pc 1uf/200v — 10 for $2.50. TRANSISTORS Sell out — 2N1637, 2N1638, 2N1639, OC602, 2N412, 2N591, 2N641, 2N642, 2N2613 — any 10 of one type for $2.50, incredible value. ELECTROLYTICS Can type 60uf/200v — 4 for $1. ZENER DIODES — 400mv, 4.7v — 10 for $2. THERMISTORS 4 ohm, 10pc, 25 deg C — 10 for 80c. COPPER CLAD BOARDS 6" x 9" — 4 for $2, 6" x 12" — 3 for $2. FERRIC Chloride Etchant (Solid) 100 grm bag — 40c.
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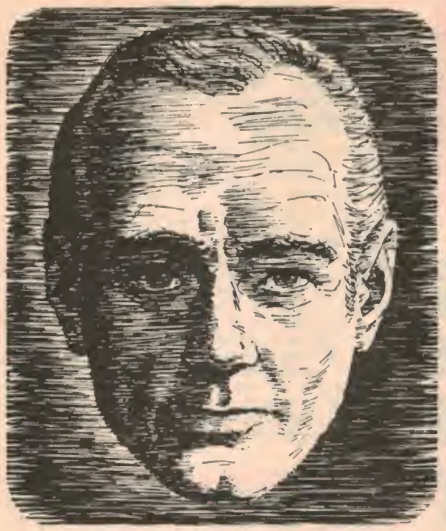

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